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SUBURBAN ELECTRIC SERVICE.

Chicago has acquired a well-deserved reputation for electrical progress, and in no wise is it better shown than in the provisions made for supplying the widely scattered suburbs with energy for lamps and motors. The North Shore Electric Company, of which a general account is given elsewhere in these columns, has for its function the supply of a wide stretch of suburban territory, in the main beyond the districts so well covered by the Commonwealth Edison Company, with which it co-operates. It furnishes another instance of the advantages of unification of electric supply. In a territory of more than 1200 sq. miles the North Shore company serves a population of 250,000 people from four modern generating stations. These replace nearly a score of small and uneconomical plants operated by non-condensing engines and run too often in the short-sighted way common in such cases. We wish that we were able here to present a full account not only of the new system, but of what it has done for the communities interested. For one thing, it has extended twenty-four-hour service over its entire territory and has thus made possible the advantageous use of motors everywhere. It would be interesting in addition to know by how much the price of electrical energy has been reduced to the average consumer. That it has been reduced goes without saying, but we fancy the amount would upon the whole be rather surprisingly large, even though it is safe to assume larger receipts from the community arising from larger use. There is no place in which consolidation produces a more striking economic result than in just this class of service.

Consumers have the cheerful habit of kicking at monopolies on general principles. It would be a good thing if they would cease from this diversion long enough once in a while to see what the net result of, say, five years of electrical monopoly has been upon the price of the commodity. Electric service is, in fact, about the only item in the cost of living that has been steadily reduced during a period of phenomenally rapid rise in prices. And electric supply companies are notable in that they have not squealed and whined over increased expenses, begging public sympathy and permission to raise prices, but in a manly way have met the situation by improving their methods of generation and distribution. It is just the policy typified by the work of the North Shore Electric Company that has won out. As to methods, the company in question has simply followed good current practice without attempting anything in the least radical. It has kept its voltages within moderate limits and its distribution system to simple and safe lines. If one were to offer any criticism it would be that the work here and there errs on the side of conservatism. With a territory eighty miles in length and more than thirty in extreme width it is probable that the present voltages might be materially raised to great advantage. One does not usually, however, get the chance to lay out a territory like this, as a whole, with a free hand, and so in this instance the scheme bears marks of pro-

gressive development and of occasional temporizing with difficulties on the whole best met by radical remedies. For instance, it is here and everywhere rather unfortunate to be operating at two frequencies for the sake of more conveniently supplying energy for railway service. This service is a logical part of the work of a great network of supply, but is it necessary to use 25-cycle generators for the purpose? Would it not be much better in most instances to secure uniformity in the generating plants by making a deal for the employment either of 60-cycle synchronous converters or of the beautiful synchronous converters used abroad which run at about half synchronous speed and thus give 30-cycle conditions of commutation on a 60-cycle supply?

As at present constituted the whole system is served from nine substations, distributing energy at 2300-4000 volts to the working lines. At three points the high-tension system is connected to the transmission circuits of the Commonwealth Edison Company so that there can be effective interchange of energy when desirable. Two of these touch the 2000-volt underground "ring" mains, a feature of distribution that might with great advantage be copied in every large urban territory. The ring system, indeed, is considerably used in the North Shore work, and wherever it has been possible each ring has been supplied from two independent sources, while the lines to the substations are generally in duplicate. The whole system is divided into three operative divisions, each worked from a convenient headquarters in telephonic touch with the others and with all important points in the system. In a network thus constituted not only is the energy supply obtained on much more favorable terms than with the separate stations replaced, but the service is as a whole much more reliable and better regulated. With the great generating equipment available and the diversity of demand usually found the conditions for uniform voltage at any one point are materially improved if reasonable care be exercised. The three load curves shown in the article point a moral. One substation shows a peak from 4 p. m. to 5 p. m., another a very sharp peak at 6 p. m. due to residence lighting and a third a blunt peak lasting from 5:30 to 7:30. The amount of diversity in demand is very striking and the result of experience frequently shows that even in so apparently homogeneous a load as is found in suburban territory the time-variation of demand is so considerable as to be a very important factor in the service conditions. The bigger the system the better are the service conditions and the greater the advantages of unified supply.

THE DIRECTION OF ROTATION IN ALTERNATING-CURRENT VECTOR DIAGRAMS.

Two very interesting papers were presented by title at the recent mid-year meeting of the American Institute of Electrical Engineers at Pittsfield and Schenectady, by Prof. W. S. Franklin and Prof. E. J. Berg respectively, on the subjects of vector-diagram production and rotation. One of these papers is a brief for one direction of rotation and the other paper for the other, the idea being that these two short papers, with the discussion on them, might serve as evidence before the International Electrotechnical Commission and aid in arriving at a decision as to the best direction for international adoption and standardization. It is a sad but evident fact that the literature of alternating-current technology is divided into two classes; namely, that in which as time advances the vectors in the vector diagrams rotate clockwise and that in which they rotate in the opposite direction, or counter-clockwise. A vector diagram is a conventional diagram for representing to the eye conveniently and comprehensively a number of quantitative cyclic relations in an alternating-current circuit. Some of these relations are complicated and involved, so that the vector diagram is a bridge upon which to pass over deep-water mathematics. The bridge thus comes to assume fundamental significance in the mind, and it is very awkward to have to reverse this bridge, end for end, in passing from one textbook or pamphlet to another. Some readers have trained themselves to be ambidextrous in this respect and profess to be able to read the dial diagrams just as well from the back as from the front of the clock; but the average student becomes so wedded to one direction of rotation that he derives very little pleasure or profit from reading diagrams of the contrary rotation. German writers frequently place an arrow on their vector diagrams to point out clearly in which sense the time is to cause rotation.

The two Institute papers show that the two opposed methods are derived from pure mathematics by different routes—the one via trigonometry and trigonometrical projections, the other via polar co-ordinate representation, with time as the argument. Each method uses fundamentally the same direction of positive rotation. Each of the two methods may, therefore, claim to be based on fundamental mathematics and neither can maintain that the fundamental principles of the other are wrong. The whole question is one of use, convenience and convention. The polar co-ordinate method claims that it lends itself readily to finding the equivalent sinusoidal values of a complex wave-form. The clock-diagram method claims that it lends itself readily to harmonic analysis for Fourier components. It is earnestly to be hoped that the International Electrical Congress will carefully consider the question and issue a unanimous decision at Turin in September. We believe that its decision would be respected in all countries and that the present chaos would give way to uniformity. Probably nothing the commission could do would be so universally useful.

ELECTRIFICATION THE ONLY PRACTICAL PREVENTIVE OF LOCOMOTIVE SMOKE.

With the example of New York City before it Chicago has been struggling for years to obtain the electrification of railroad terminals within its borders. But as there are some twenty-six trunk-line railroads entering Chicago, using six passenger terminal stations, five being union stations, with an elaborate system of interchanging freight, the problem is a very serious one, from which the railroads shrink, although probably nearly all progressive steam-railroad operators are willing to admit privately that electrification of the Chicago terminals is bound to come at some future date—to be staved off as long as possible. Electrical men appreciate the gravity of the problem, but most of them who are familiar with the situation believe that the railroads will display greater wisdom, in this day of keen surveillance of public utilities, to take the bull by the horns and make an honest effort to meet the demands of the people—that is, to make a start in the right direction now rather than to wait until forced to make the change by the irresistible force of thoroughly aroused public opinion, with more drastic requirements than would now, perhaps, be enforced.

The charge against the steam locomotive discharging smoke and cinders into the air, and with the noise of its exhaust, is that it constitutes an intolerable nuisance in a densely populated city. In Chicago the railroad men have answered that the lomomotives make but a small proportion of the total smoke and that, from the viewpoint of smoke prevention, the electrification of railroad terminals is unwarranted. To investigate this claim the Department of Smoke Inspection of the City of Chicago has made a study of the subject, and as the result Mr. Paul P. Bird, smoke inspector of the city, read an interesting paper before the Western Society of Engineers a few days ago on "Locomotive Smoke in Chicago." Mr. Bird finds that the steam locomotives of the city use 18.5 per cent of the total amount of soft coal consumed, but they produce 43 per cent of the total smoke and over one-half of the dirt traceable to smoke. This is due to unavoidable defects in the locomotive, compared with stationary steam plants, by which the smoke from the former is much more dense and carries a large amount of cinders. Indeed, Mr. Bird makes the startling estimate that 560 tons of cinders are thrown into the air from the stacks of locomotives in the City of Chicago every day.

Considering possible remedies for this state of affairs, the author examines the suggested use of semi-bituminous coal, anthracite coal, coke or oil as fuel for locomotives. But all of these are objectionable, for reasons which are given, and Mr. Bird is forced to the conclusion that electrification of railroad terminals affords the only solution of the problem. "The study that has been made along these lines," he says, "indicates clearly that electrification offers the only final and satisfactory solution of the locomotive smoke problem. The use of special fuel for preventing smoke on steam locomotives is only a makeshift and will not satisfy the public." This is positive language, but the conclusion seems to be justified fully by the facts in the case. The municipal authorities, the various associations of business men, the newspapers, the women's clubs, the "Chicago plan" advocates and the other agencies that are fighting the inertia of the powerful railroad corporations in Chicago to bring about electrification will find in Mr. Bird's paper a strong weapon of attack.

A METHOD FOR STUDYING THE INTERNAL INDUCTANCE OF LINEAR CONDUCTORS.

In dealing with a natural phenomenon in a practical way, for the purposes of engineering and business, there is a certain order of progress and development, which is partly real and objective, partly psychological and subjective. Let us suppose that the phenomenon is the ordinary flow of water through a tube, as utilized in hydraulic supply mains. The first step is made when the process is applied to any practical extent, no matter how crudely, as when water from a spring is conducted to a little hamlet through a ditch or duct. The next step is when pipes are made to carry the water underground so that the supply does not freeze up in winter. Another step is when long aqueducts are made over hill and valley for carrying a large supply of water to a city. In each succeeding step new problems arise, new laws have to be discovered, new principles established, and knowledge increases with never-ending ramification. Details which would seem too trivial to consider at one stage become of critical importance at a later stage. The solution of one problem becomes in turn but the formulation of the terms of a new and deeper problem. But with each solution new knowledge and new powers are gained.

The linear inductance of a conducting loop, such as may be formed by a pair of parallel wires, affords another instance of the same sort as the above. A pair of aerial parallel copper wires have a linear inductance of, say, 4 millihenrys per mile of loop. This inductance is mainly due to the magnetic flux linked with the conductors and in the air between them. A relatively small part is due to the magnetic flux inside the copper wires. If, however, iron be substituted for copper the linear inductance may be increased to, say, 30 millihenrys per mile of loop; for, owing to the vastly greater permeability of the iron in the substance of the wires, the magnetic flux inside the wires is greatly intensified, although the permeability of the air in the loop external to the wires has not changed, so that the internal linear inductance is now about 26 millihenrys per mile and the external inductance about 4. The exact values of the internal linear inductance are not easy to predetermine. The permeability of the iron is not uniform, but, as we know, varies with the magnetizing force. This magnetizing force differs at different radial distances from the axis of the wire, so that a sort of average magnetic permeability has to be found by experiment. Experiments thus far published show conclusively that the permeability varies with the strength of the current in the wire.

Again, it is well known that an electric current is a phenomenon involving both the conductor and the dielectric outside the same. The current always starts at the bounding surface of the two, as we understand the process, namely, at the surface of the wire, and extends thence both ways. It penetrates as an electronic transfer inside and downward in the conductor. It penetrates as a distribution of electromagnetic flux into and through the dielectric. If the rate of alternation of the current is sufficiently rapid it does not penetrate beyond a certain skin-depth into the conductors. This alters both the effective linear resistance and the effective linear inductance of the conductors. Moreover, the magnetic field set up in the wire is not concentric with the axis of the wire if the two wires forming the loop lie close together. Hence arises an additional complexity in the results. Consequently, we have as yet no formula upon which we can rely for expressing precisely the linear inductance of an iron-wire loop. Measurements have been made and published of the inductance of such loops, but owing to the shortcomings of our mathematical processes in the above respects these measurements have not yet been reduced to definite analysis. When very feeble currents are used, in not large iron wires and at low frequencies, the average permeability ordinarily appears from the measurements to be in the neighborhood of 150. When more powerful currents are used the permeability rises very greatly, but just how high it is hard to say, owing to the combined effects of non-uniformity, skin effect and flux eccentricity. Mr. Frank F. Fowle suggests in his article, on page 485, a particular plan of testing iron-wire loops from which the permeability may be deduced on the assumption that it is uniform throughout the substance of the conductor and also that the skin effect is negligible. The going and returning conductors are made concentric so as to eliminate the eccentricity of magnetic flux. Experimental observations in this direction are much needed, provided that they are followed up mathematically to a reliable conclusion.

Program for Minnesota Convention.

The program for the fourth annual convention of the Minnesota Electrical Association, to be held in St. Paul on March 14-16, has been carefully prepared and includes papers as follows: *Curb Lighting,* Ludwig Kemper, Albert Lea; *Window and Sign Lighting,* George Steinwedell, St. Paul; *Residence Lighting,* C. E. Van Bergen, Duluth; *Sales Departments for Small Cities,* Herbert Markle, Stillwater; *Gas-Producer Engines for Central Stations,* A. W. Wagner, Huron; *Gasoline Competition,* by a representative of the National Electric Lamp Association; *Testing Wattmeters,* F. R. Cutcheon, St. Paul; *Engine and Boiler-Room Records,* E. Holcombe, St. Paul; *Insurance,* Mr. Ritt, St. Paul; *Day Load for Central Stations,* E. L. Callahan, Chicago; *Incandescent Lamp Improvements,* Henry Schroeder, Chicago; *Safety in Line Construction,* H. G. Winsor, Minneapolis.

The convention will be held in the sun parlor of the handsome new St. Paul Hotel. There will be a banquet in the palm room of the hotel and visits are planned to the plants of the Northern Heating & Electric Company and St. Paul Gas Light Company, including the celebrated sand-rock tunnels of the latter. Mr. Robert W. Clark, of Minneapolis, is president of the association.

Electric Railway Investigation in Providence and Buffalo.

At the request of the Mayor and Common Council of Providence, R. I., Mr. B. J. Arnold, chief engineer board of supervising engineers, Chicago Traction, will conduct an examination of the surface-railway conditions of Providence and will present a report on this subject with recommendations as to the improvements. On Feb. 11 Mr. Arnold outlined in a speech before the Conservative Club at Providence some of the problems which were confronting street railway companies at the present day and the methods which had been adopted in other cities, particularly in Chicago, to improve the local street-railway system. According to Mr. Arnold the best results are secured only when the subject is approached in a broad and co-operative spirit by the public, the company, the city government, the property owners and the financiers interested in the property. Other speakers were Mr. Edward G. Buckland, vice-president of the Rhode Island Company, which controls the electric railways in Providence, and Mr. Henry Fletcher, Mayor of the city.

Mr. Arnold has also been engaged by the International Traction Company of Buffalo to make an appraisal of its properties. This appointment was made because of proposed refinancing plans of the company for which the Public Service Commission, Second District, New York, required an appraisal of the physical property of the company. The company submitted the name of Mr. Arnold as appraiser to meet this requirement and the commission approved his selection.

Illinois Electric Railways Association.

At the meeting of the new Illinois Electric Railways Association in Chicago on Feb. 17 permanent organization was perfected, with Mr. H. E. Chubbuck, Illinois Traction System, president, and Mr. C. E. Flenner, Aurora, Elgin & Chicago Railroad, secretary. A constitution and set of by-laws were adopted. Active members consist of electric-railway companies, paying $10 initiation fees and 50 cents per mile of trackage as annual dues, and supply companies, paying $25 a year per company member. Associate members are individuals, who may be non-residents of the State, and pay $5 a year. Meetings are to be held in January, March, May, September and November of each year. In relation to suggested affiliation with the Central Electric Railway Association of Indiana and Ohio the committee previously appointed reported favorably on the proposal, but the report was laid on the table. A committee on automatic signaling was appointed. It consists of Messrs. G. T. Seeley, South Side Elevated Railroad, Chicago; John Leisenring, Illinois Traction System, Peoria; E. F. Gould, Aurora, Elgin & Chicago Railroad, Wheaton; T. M. Childs, Chicago, Lake Shore & South Bend Railway, Michigan City, Ind., and L. E. Gould, *Electric Railway Journal,* Chicago. The next meeting of the association will be held in Bloomington on March 17.

German Commercial Methods in Japan.

United States Consul-General Thomas Sammons, at Yokohama, Japan, reports that German manufacturers recently secured an order in Tokyo for electrical apparatus and water-wheels amounting to approximately $950,000. This order was placed by the Tokyo Electric Light Company and included six 7700-kw generators and water-power turbines, twelve 4000-kw transformers, twelve 3600-kw transformers and corresponding switchboard apparatus. Of the above-named apparatus the Allgemeine Elektricitäts-Gesellschaft, of Berlin, obtained an order for about 75 per cent, namely, approximately $400,000 for electrical apparatus and $300,000 for the water-wheels. The Siemens Company, of Berlin, obtained an order for approximately $175,000 of the electrical apparatus and the Shibaura Engineering Works, of Tokyo, in which the General Electric Company is interested, obtained an order for only about $50,000 of the electrical apparatus. Consul Sammons reports that he has made a careful investigation of the prices made by the German firms and the conditions under which the order was taken, and finds that the Germans, on the electrical apparatus, were only about 9 per cent lower than the chief American competitor, the General Electric Company. These German quotations were at first understood to be quite radical; that is to say, 25 per cent to 30 per cent below American prices. It is evident, however, that some of the German manufacturers are quite willing to sell below cost in certain instances with a view to meeting competition and securing control of desirable markets.

Irrigation Pumping Plants in the Southwest.

Men interested in the reclamation of land in the semi-arid regions of the Southwest and Mexico are giving attention to the study and comparison of the different means that may be employed for placing water upon their farms. During the last few years the demand for pumping machinery has increased enormously in this vast territory of wonderful irrigation possibilities, but even the great development already accomplished is slight compared with what may be done in the future. Manufacturers and dealers in irrigation equipment are finding the new field a fruitful one for their efforts.

Without entering into a technical discussion of the different types of irrigation plants that are already in use, a review of the situation may be of interest. It has been amply shown that what may be economical to the farmer in one locality may be expensive in another. For this reason there has been no uniform adoption of irrigating pumping plants in Texas or other parts of the Southwest and Mexico. Improvements along this phase of the industry are being constantly made, however, the manufacturers standing ready to meet the demands of the farmers.

The beginning of the era of irrigating pumping machinery as a part of the farm equipment in Texas does not date back many years. Ten years ago there were a few scattered pumping plants in the territory immediately adjacent to San Antonio, used chiefly by truck growers. To-day there are hundreds of these plants in operation in that section and the land reclamation movement has extended all the way to the Rio Grande, embracing a territory that is 100 miles to 300 miles north and south by 500 miles east and west. Counting the rice-growing region of the upper Gulf coast, the width of the irrigation belt in that State is more than 1000 miles.

In Mexico remarkable progress is being made in the use of

modern pumping plants for irrigating large areas of land. Irrigation is not a new thing in that country. It was practised by the Aztecs when the Spaniards invaded the land four centuries ago. In some parts of the republic the old, roughly hewn overshot wheels, operated by man-power, are still in use to lift the water from wells and streams, allowing it to run over the land. But the touch of progress and development is being felt there to almost as great a degree as in Texas, and the wants of the farmers in this particular are being supplied chiefly by American manufacturers.

Fuel is a problem in most parts of the semi-arid region of the Southwest and Mexico. An exception is in the south Texas region, where the low-growing mesquite and other thorny varieties of timber growth cover the ranch lands and furnish cheap fuel for the comparatively few steam-pumping plants found there. In the Rio Grande Valley section around Laredo coal mines provide fuel. But, notwithstanding the abundant wood and coal resources, it has been found cheaper to use gasoline engines or electrical equipment for the pumping plants. Another fuel resource just made available for the great number of irrigation pumping plants in the Laredo region is natural gas, piped through the Bermuda-onion and other vegetable farms from the Reiser gas field, about twenty miles distant. The adoption of natural gas for fuel for the engines promises to become general in that part of Texas, although before this fuel supply was available electric transmission lines were constructed from a central power plant in Laredo up and down the valley, and many of the farmers were using this energy to operate their pumps. Notwithstanding the fact that the water lift on the Rio Grande in the vicinity of Laredo ranges from 55 ft. to 105 ft. the cost of placing water upon the land is said to average less than in most irrigated localities. Of course, this cost depends largely upon the kind of crop that is being grown, but even for Bermuda onions, which require an unusual amount of water, the expense from this source for the farmer has ranged from $10 to $12 per acre per year.

There are about thirty-eight irrigation pumping plants in the lower Rio Grande Valley, in what is known as the Brownsville country, more than 300 miles below Laredo. All of the irrigation plants in the lower Rio Grande Valley are of very large capacity, ranging from 50,000 gal. to 150,000 gal. of water per minute each. Each one of these plants is operated by electric power and the others by either gasoline or steam.

In the more western part of Texas, in the plateau region of Mexico and in most parts of the arid region of New Mexico and Arizona producer-gas and gasoline engines are used to operate the pumping plants. Electrical energy has come into use for this purpose in some localities, particularly in the Mimbres Valley around Deming, N. M., and in the vicinity of Portales. Hydroelectric plants, which have for their chief purpose the furnishing of power for irrigation pumps, are proposed for a number of localities in Arizona and Mexico. As an auxiliary to the great land reclamation of the government in the Salt River Valley of Arizona a hydroelectric plant near Phœnix will supply a large amount of power for the farmers. At a point on the Conchos River eighteen miles from Santa Rosalia, Mex., a Canadian syndicate is building a great water-storage reservoir and will install a hydroelectric plant and pumping machinery to irrigate about 250,000 acres of valley land. There are many other similar enterprises of lesser size on foot in that country.

In Mexico the producer-gas engine is coming into even more general use for operating irrigation pumps and other machinery than in the semi-arid region of this country. Many engines of this type have been installed during the last year in the States of Durango, Coahuila, Chihuahua, Sonora, Nuevo Leon and Tamaulipas, where the land is particularly well situated for irrigation. It is claimed by Americans and Mexicans who have placed producer-gas engines in use that they are not only cheaply operated but they are easily handled by the natives. Charcoal is comparatively inexpensive in most parts of Mexico. In the plateau region of Durango, where there are many of these engines, the charcoal is brought down from the timber-covered mountains by native burners.

Producer-gas engines for operating pumping plants in the upper Rio Grande Valley of New Mexico and Texas, as well as on the Mexico side of the international boundary stream, in the territory that is to be embraced in the great Elephant Butte reclamation project, are strongly advocated by P. E. Fuller, the United States engineer and expert who is in charge of the pumping and irrigation investigations in the Salt River Valley of Arizona. The owners of the land to be irrigated by the Elephant Butte project have formed a water users' association which contemplates installing a hydroelectric plant at the dam to cost about $326,000, providing energy for operating auxiliary pumping plants on the farms. In a recent address before this association Mr. Fuller advocated the establishment of a pumping plant on every 160 acres in the valley. Pending the installation of the proposed hydroelectric plant he urged the use of producer-gas engines to operate the individual pumping plants that are to be established. He said that pumping against a 70-ft. or 80-ft. head was not impracticable when producer-gas engines are used. To install a large pumping plant, sufficient to irrigate about 15,000 acres at 30-ft. lift, the initial cost per acre would be about $28, using producer-gas generated from coal costing $4.40 per ton. The cost per acre-foot at the well is placed at $1.90 and the cost of placing three acre-feet of water upon the land per year is estimated at $5.70.

In the vicinity of Douglas, Ariz., a project is being promoted for establishing pumping plants to irrigate about 10,000 acres. All through the ranch territory of South Texas pumping plants to irrigate tracts of land ranging in size from 1000 acres to 25,000 acres are being installed or are under consideration. Besides these larger propositions there are scores of smaller irrigation projects of individual farmers who have from ten to 200 acres that are to be watered in this manner. In some localities of western Texas where running streams of water are not available it is found practicable to harness a number of surface wells to one pumping plant and so obtain a supply of water to irrigate a large acreage of land.

Scope of the Illuminating Engineering Society.

At the weekly luncheon of the Electric Club of Chicago on Feb. 15 Mr. F. J. Pearson, chairman of the Chicago Section of the Illuminating Engineering Society, read a short paper on "The Illuminating Engineering Society—Its Origin, Scope and Future." Mr. Pearson gave an outline history of the society from the first meetings in 1905, which resulted in its formation the next year. He told of the benefits of the organization to merchants, central-station operators, manufacturers and others, and in a general way gave the members of the Electric Club an idea of the scope and influence of the society. One interesting fact he mentioned was that about 60 per cent of the members of the society are electrical men, about 20 per cent connected with gas lighting, while the remaining 20 per cent may be classed as "miscellaneous."

In the discussion Mr. George C. Keech, first chairman of the Chicago Section, spoke about the remarkable series of lectures last year at Johns Hopkins University and also referred to the coming annual convention of the Illuminating Engineering Society to be held in Chicago. Mr. J. R. Cravath, also a former chairman of the Chicago Section, referred in an interesting manner to the origin of the term "illuminating engineer" some eight or nine years ago. Mr. F. H. Bernhard, the secretary of the Chicago Section, told of the work of the local section, and Mr. George H. Stickney, of Schenectady, alluded to the importance of the subject of illuminating engineering and also to the value of the work of the society in collecting engineering data to aid illuminating engineers.

Mr. F. P. Vose reviewed briefly the relations of architects and electrical contractors. It is often the case, he said, that contracts for electrical work drawn by architects are decidedly unfair to the electrical contractors. The architect's decision is final, and sometimes very unreasonable and inequitable exactions are made. The speaker would like to see some move-

ment on the part of the electrical contractors to combat the tendency of architects to exact unreasonable terms in relation to electrical construction. Mr. H. E. Niesz, president of the club, said that the Electric Club would be glad to co-operate with the electrical contractors in furthering such a movement. The thanks of the club were extended to Mr. Pearson for his instructive address.

Economic Limitations to Aggregation of Electrical Systems.

At a meeting of the American Institute of Electrical Engineers held in Boston on Feb. 17, Mr. Robert A. Philip, of the Stone & Webster Engineering Corporation, Boston, presented a paper dealing with the economic limitations to aggregation of electrical generating and distributing systems. The paper was particularly timely in view of the paper of the week previous at the New York meeting by Mr. William B. Jackson, of Chicago, on unified electric systems covering large areas. Mr. Philip's paper consisted of two principal sections, the first discussing the economic value of electric service on the basis of many broad generalizations of unique interest, and the second treating mathematically the phenomena and conditions surrounding the transmission of energy through networks of great magnitude. The author's conclusions were summarized as follows:

Electricity is essentially a secondary source of energy standing in the relation of a common medium of exchange to other energies. Prime energy is like property, electric energy like money. Every circumstance unfavorable for economical generation can be found in varying degrees among isolated plants, while central stations may take advantage of every practicable economy. The public-service corporations which distribute energy constitute clearing houses for balancing the individual increases and decreases of energy requirements of a community as a whole and provide a centralized reserve for meeting promptly any total net increase. In the aggregate the disproportion of isolated prime movers in their fields must be enormous. Diversity factor contains almost inconceivable possibilities. It is to be expected that in time the country will be covered with high-tension lines. The large plant gives centralized reserve, the large system gives a diversity factor among accidents and an interchange of reserve. Electric energy, though poured in unlimited amounts into a system of indefinitely great extent, must be as mobile as trains on a railroad network, must be universally uniform in quality, must never be totally interrupted, and though in amount unlimitedly great must not be uncontrollable. To meet these requirements electric transmission must take the alternating-current form and the energy should be transmitted at constant potential. Finally, this system is one using high reactance made transparent by leading wattless currents and transmitting energy by displacing the phase of the voltage instead of varying its amount.

Discussion.

Mr. J. F. Vaughan, Boston, commended the extension of large systems as beneficial in solving the smoke problem by wiping out the small coal-burning plants. Already the aggregation of systems has been carried to a great extent and there appears to be scarcely any limit except the rupturing capacity of the individual oil switch.

Mr. N. T. Wilcox, Lowell, Mass., emphasized the effect of low-cost cement in reducing the expense of water-power development and urged the need of good engineering in network planning. A poor engineering job becomes a permanent tax on a property. The saving in investment through diversity factor is of vast importance. As Mr. Torchio pointed out the week before in New York, there was only 24 per cent reserve in equipment in the New York Edison system in 1909 compared with 66 per cent on twenty-seven supply systems in London.

Prof. C. A. Adams, of Harvard University, submitted interesting graphic illustrations of the points concerning the use of synchronous apparatus discussed in Mr. Philip's paper.

Mr. J. Echen, Boston, touched upon the difficulties of voltage regulation with large inductive loads. Conductors of large size tend toward high reactance and increasing voltages bring trouble from corona loss.

Dr. A. E. Kennelly, Harvard University, commented on the tendencies toward mutually interlaced systems and brought out the new conceptions of regulating methods which must be maintained on such systems—voltage that is constant rather than unity power-factor. That means many synchronous motors with fields adjusted to give the right amount of leading current at the various points of the network, with adjustment as the load varies. This principle is likely to be approached as systems grow. If an inductive load goes off the line very suddenly a large change in field strength becomes necessary. It is not altogether advantageous to have high inductances in the line. Surges are more likely under such conditions.

Mr. E. N. Lake, Boston, emphasized the importance of uniformity and standardization in large networks.

President Dugald C. Jackson reviewed the benefits of unified electric systems and pointed to the struggle between plant sizes and controlling devices corresponding to that between guns and armor plate. He felt it to be a matter of congratulation that Mr. Philip has shown that a short-circuit on a nation-wide network could affect only a limited area. Phase control is more important than voltage control in large systems.

In closing Mr. Philip sketched the possibilities of using independent disconnecting devices and automatic regulators of synchronous apparatus on great systems. When the limit of circuit-breaking devices is reached it will be necessary to resort to reactance, but controlling mechanism has not yet been carried to its ultimate development. He felt that systems would be developed to meet the conditions, although many details are still unsettled.

Alternating-Current Motors for Elevator Service.

At the regular monthly meeting of the Pittsburgh Section of the American Institute, held Tuesday evening, Feb. 14, in the rooms of the Engineers' Society of Western Pennsylvania, the subject of "Alternating-Current Motors for Elevator Service" was discussed. The discussion was confined generally to polyphase motors, although single-phase motor applications were mentioned by some of the speakers.

Mr. W. H. Patterson, of the Westinghouse Electric & Manufacturing Company, opened the discussion with a paper illustrated by views of apparatus and curves dealing with the subject from the manufacturers' point of view. He stated that there were two kinds of polyphase motors used for elevator work, namely, squirrel-cage motors with high-resistance secondaries and slip-ring motors with external resistance in the secondaries. The former is much simpler, the control consisting of a reversing switch mounted in any convenient location. It has characteristics particularly adapting it to elevator work, such as maximum torque at starting, decreasing as the speed increases, which is just what is needed for such work. This type of motor gives twice full-load torque with two and one-half times full-load current at starting and so may be connected directly on the line without any starting device. Another characteristic possessed by this type of motor which makes it particularly adaptable to elevator service is that the starting torque is equal to the "pulling-out" torque. Thus the acceleration is smooth, a fact that adds greatly to the comfort of the passengers. The motor has a relatively high power-factor at starting and, it was stated, would not affect the lines so much as a constant speed squirrel-cage motor. At the present time the motors are limited in capacity to from 18 hp to 20 hp.

The slip-ring motor is used with some form of controlling device and for elevator speeds of from 250 ft. to 300 ft. per minute. The great difficulty with alternating-current motors in this service is the braking, which with direct-current motors is a comparatively simple manner, as the motor acts as a gen-

erator, being short-circuited through a resistance. The slip-ring motor develops twice full-load torque with twice full-load current at starting, but the power-factor is not so high as that of the squirrel-cage type during this period. Alternating-current motors for elevator service have been in use for several years now and have fully demonstrated their adaptability for this class of work.

Mr. F. E. Town, of the Otis Elevator Company, described the magnet control of slip-ring motors and explained the difficulties encountered in their application as compared with direct-current motors, particularly with regard to braking. Mr. H. D. James gave an interesting review of the history of alternating-current motor application from its inception, dealing with the commercial as well as the engineering features. He called particular attention to the fact that elevators carried human freight and no chances could be taken which would in any way lessen the factor of safety. An accident would not only be the cause of a damage suit, but would endanger the reputation of the system used. The general discussion was participated in by several engineers who viewed the subject from the standpoints of manufacturer and central-station operators.

Illuminating Problems in Small Towns.

The subject for discussion at the meeting of the Chicago Section of the Illuminating Engineering Society on Feb. 16 was "Illumination Problems in the Smaller Cities." No set paper was presented, but several members took part in a general discussion. Mr. J. R. Cravath said that the illuminating problem in the small city is essentially one for the central station to meet. The lighting company should see that its customers get the best results for their money. The speaker considered illumination as applied to stores, residences and streets. The merchants in the small towns are prone to use drop-cord lamps on the level of the eye, and it is hard to get them to spend money for diffusing or reflecting glassware. They are accustomed to the glare of gasoline lighting units, and are apt to think that if there is no glare the light is insufficient. However, conditions are gradually improving, and in many small cities and towns there are numerous stores with high-level light sources supplied with reflectors. In residence lighting there are still many small houses that have nothing but lamps attached to drop cord. Where fixtures are used they are often poorly designed, and it should be the business of the central station to see that the supply dealer of the town carries fixtures that will permit of modern efficient lighting.

Where drop cord is used the lighting may be improved by attaching tungsten lamps at the ceiling and controlling them with pendent or wall switches. In street lighting a frequent country-town condition is that of an arc lamp at every other street corner, lamps thus being spaced from 600 ft. to 1200 ft. apart. This lighting is not only insufficient, but it produces a conspicuous glare effect. The solution seems to be to use tungsten lamps spaced more closely together—perhaps a 100-watt lamp at each street intersection. But not all small cities have inefficient street lighting, and Mr. Cravath spoke of the example of Albert Lea, Minn., a city of 6000 inhabitants, where ornamental posts, each supporting a 60-watt lamp, are spaced at intervals of 55 ft. on one residence street, while on business streets the same type of post, but supporting three lamps of the same size, is used, spaced at the same intervals. This accomplishment shows the possibility of educating the people in smaller cities to the use of modern street lighting.

Mr. C. A. Luther, of the People's Gas Light & Coke Company, Chicago, remarked that there is a great field for educational work in the smaller cities and, indeed, in the large cities also. There is such a thing, he said, as overburdening the customer with light, and this is not good practice. The Illuminating Engineering Society should be of particular benefit to the employees of small companies, and these companies will do well to insist on having such of their employees as are engaged in lighting work join the society.

Mr. A. L. Eustice commented on the lack of reflecting devices in small towns.

Mr. C. A. Howe corroborated Mr. Cravath in the assertion that the problem is "up to" the central-station man in the small town. There is an almost limitless field to teach the manner of obtaining proper results from light sources. The lamp-manufacturing companies and the manufacturers of reflectors are conducting educational campaigns along this line. A general manager for a syndicate of small companies can do much good in carrying on this educational work, both on his own account and by calling to his aid the illuminating engineer. The smaller cities are waking up to the importance of this subject, and the society should lend them its aid.

Mr. J. G. Learned, of the North Shore Electric Company, told of the value of lectures on the elements of illuminating engineering as conducted by the commercial lighting interests. His company, which does a suburban central-station business, realizes the practical importance of illuminating engineering, which places in the possession of the solicitor a means of convincing lighting customers that the company is really trying to serve their interests. Ignorance on the part of customers and prospective customers is the greatest obstacle encountered in selling electricity in small towns. Here is a great field of work for the Illuminating Engineering Society. Perhaps it might co-operate with the fixture manufacturers and the electrical contractors, or perhaps it might go farther and reach the public at large through articles in the popular magazines, for illuminating engineering is a subject that is of importance to all persons who use their eyes by artificial light.

Dr. Herbert E. Ives, of Cleveland, vice-president of the general society, representing the Chicago Section, was introduced and spoke on society matters, referring to the coming Chicago convention, the plan of forming local or section membership committees and the formation of a new committee on research. Dr. Ives advocated joint meetings with medical societies, boards of education, college faculties, etc., to spread knowledge of proper methods of illumination. There is endless opportunity, he said, for general missionary work along this line.

Mr. Preston S. Millar, of New York, general secretary, spoke briefly on society matters, referring to the thriving condition of the organization.

Electrification Only Remedy for Railroad Smoke Nuisance.

At the meeting of the Western Society of Engineers in Chicago, Feb. 15, Mr. Paul P. Bird, city smoke inspector of Chicago, presented a paper on "Locomotive Smoke in Chicago."

Chicago, said Mr. Bird, is the greatest railroad center in the country and one of the greatest manufacturing centers. Soft coal from Illinois and Indiana is the universal fuel used, and the result has been the fouling of the atmosphere with large quantities of smoke and dirt. Railroad men have contended that the railroads make but a small part of the total smoke of Chicago, and that from the viewpoint of smoke prevention the electrification of railroad terminals is unwarranted.

An investigation made by the city department of smoke inspection, however, has brought out the following conclusions: Although the locomotives of the city use only 18½ per cent of the total coal, they make 43 per cent of the total smoke and over one-half of the total dirt, sparks and cinders. The locomotives consume, within the city limits, 5600 tons of soft coal daily, or about 1,850,000 tons annually. According to the Ringlemann system of smoke density the average locomotive smoke in Chicago is 23 per cent. The lowest average density of smoke produced by any one road is about 10 per

cent, probably as low an average as can be maintained with soft coal. If all locomotives in Chicago maintained an average smoke density as low as 10 per cent, the locomotive smoke would still form 29 per cent of the total smoke and probably produce over one-third of the dirt. Locomotives in the neighboring towns outside of Chicago make an average smoke density of about 41 per cent, showing that the anti-smoke campaign in the city has already reduced the smoke nearly one-half. Approximately 10 per cent of all coal fired in a locomotive fire-box is discharged from the stack in the form of cinders. Within the city limits of Chicago about 560 tons (fourteen carloads) of cinders from locomotive smokestacks are dropped every day. There are 2200 miles of railway track in the city limits, and at all times about 1400 different locomotives working in the city.

There are nearly 7000 high-pressure stationary steam boilers in Chicago, their total rating aggregating 1,000,000 hp. An average of 5 lb. of coal is used per boiler hp-hour.

Mr. Bird grouped smoke-producers into seven classes: (1) Central district, or downtown, stationary boiler plants, chiefly in office buildings, hotels, warehouses, factories, etc. (2) Miscellaneous power plants not in central district, including all stationary high-pressure boiler plants in factories, mills, electric power houses, packing houses, breweries, etc. (3) Flat and apartment buildings. (4) Domestic heating. In classes 3 and 4 are included low-pressure steam heating or other domestic heating plants using soft coal. (5) Special furnaces. This class includes all special furnaces used in various manufacturing processes, as iron and steel plants, kilns, annealing ovens and the like. (6) Railroad locomotives. (7) Steam vessels. The accompanying tables shows the coal consumption and smoke produced by these classes:

Class	Consumer.	Annual Coal Consumption, Tons	Per Cent.	Per Cent. of Smoke Density.	Per Cent of Total Smoke.
1	Central district.....	1,500 000	15.0	3.75	6
2	Misc. power plants..	4,500,000	45.0	6.5	30
3	Flats.....	750,000	7.5	3.0	2½
4	Domestic.....	650,000	6.5	3.0	2
5	Special furnaces....	600,000	6.0	20.0	12½
6	Railroads.....	1,850,000	18.5	22.3	43
7	Boats.....	150,000	1.5	25.0	4
	Total.....	10,000,000	100.0		100.0

From 8 per cent to 18 per cent of all bituminous coal put into locomotive fire-boxes is discharged from the stack as sparks and cinders, while in stationary plants, where the coal is burned with low draft and tall chimneys, few cinders are carried out with the smoke. Smoke from locomotives is hence far more objectionable than that from stationary plants, besides being discharged near the ground and trailed over long courses.

Mr. Bird points out that general use of anthracite coal or of coke for locomotives would eliminate smoke, but the other nuisances due to steam locomotives would not be diminished. Fuel oil makes very objectionable smoke unless carefully handled. The general use of any specially selected fuel will greatly increase the cost of that fuel to the railroads and the practical difficulties involved would make it a very difficult reform to bring about. The locomotive fire-boxes would have to be changed if coke or hard coal were used. Concluding this phase of his investigation, Mr. Bird makes the emphatic declaration: "The study that has been made along these lines indicates clearly that electrification offers the only final and satisfactory solution of the locomotive-smoke problem. The use of special fuel for preventing smoke on steam locomotives is only a makeshift and will not satisfy the public."

In the discussion following Mr. Bird's paper a number of steam-railroad men took part, and they all opposed electrification, or at any rate any immediate attempt at electrification. Some of them spoke in vigorous language. Others discussing the paper were: Messrs. William B. Jackson, A. Bement, R. H. Kuss, Albert Scheible, P. M. Chamberlain, Dr. W. A. Evans, H. H. Evans and M. L. Harris.

Pittsfield-Schenectady Convention of the A. I. E. E.

The opening session of the mid-year convention of the American Institute of Electrical Engineers was held at the Mohawk Golf Club, Schenectady, N. Y., on Tuesday afternoon, Feb. 14. The introductory remarks were made by Mr. E. A. Baldwin, chairman of the Schenectady Section, who explained in detail the reasons for holding mid-year conventions and welcomed the visiting members both to Schenectady and Pittsfield. On account of the inability of President Jackson to attend the opening session, the reply to the words of welcome was made by Past-president Charles F. Scott. Mr. Scott outlined the growth in the membership of the Institute. About eight years ago the total membership in the largest center, namely, New York, was no greater than the present membership centered around Schenectady. Although the growth in the Institute membership has been quite remarkable, it merely reflects the growth of the electrical industry. During the past few years the engineer has considerably broadened his work so that at the present time he may be considered the most active agent in modern civilization. Most of the elements which distinguish modern from ancient civilization, such as means of transportation, communication of intelligence and expansion of the working hours throughout darkness, are attributable to the engineer.

Mr. D. B. Rushmore, senior manager of the Institute, was placed in charge of the meeting on account of the absence of the president and vice-presidents. The technical portion of the session was devoted to the presentation and discussion of three papers dealing with the general subject of materials. These papers were presented by Messrs. A. B. Hendricks, W. J. Wooldridge and H. R. Wilson.

MATERIALS.

The paper by Mr. Hendricks contained much data relating to laboratory tests made upon small samples of commercial insulating materials. Use was made of generators delivering sinusoidal e.m.fs., the machines being of both the old smooth-core type and the modern distributed-field type. For increasing the e.m.f. from the generator value to the value for testing use was made of transformers with massive cores and few turns in the winding; that is, transformers of low leakage reactance and impedance. The author stated that modern testing transformers operate at from 5 volts to 20 volts per turn as compared with from 1 volt to 3 volts formerly.

In commenting on the A. I. E. E. specifications that testing transformers should be required to withstand double normal high-tension voltage between high-tension winding and low-tension winding and core, the author stated that a better and more rational method of test is to apply an "induced" voltage 50 per cent above normal, the middle or end of the high-tension winding being grounded.

The most nearly perfect method for determining the high-tension voltage with convenience and accuracy is one involving the use of a voltmeter coil on the main core. All that is required is a coil of a few turns inserted symmetrically at the middle of the high-tension winding and connected thereto at the neutral point. This method is far preferable to the spark-gap method, which is liable to be the source of error and trouble. For example, when the known e.m.f. (found by the conversion ratio) was 69,300 volts, the e.m.f. indicated by spark-gap varied from 86,000 to 73,800, according to whether the gap was used alone or with resistance in parallel.

The paper contained reports of tests on oil, pressboard, wood and hard fiber, presented in the form of curves showing the dielectric strength, specific capacity, arcing voltage, time test and energy loss under various conditions. It also con-

tained numerous suggestions relating to the methods for testing solid and liquid materials.

The paper by Mr. Wooldridge dealt with the hysteresis and eddy-current exponents for silicon steel. Experience has shown that the core loss in silicon steel operated at high densities cannot be predicted from the values obtained at low densities by use of the well-known eddy-current and hysteresis exponents of 2.0 and 1.6 respectively, on the basis of constant coefficients, as is generally done. The author separated the eddy-current loss value from the hysteresis loss value and attributed the change from the predicted values to variation in the exponents. He assumed that the eddy-current exponent varied from 2.0 at 6000 lines per square centimeter to 1.6 at 16,000 lines per square centimeter, while the hysteresis exponent was assumed to vary from about 1.57 at 6000 lines to 3.2 at 16,000 lines per square centimeter. The tests were made on 0.014-in. sheet steel.

The paper by Mr. Wilson dealt with those features of transformer design which are affected by commercial requirements, with special reference to the limits of standardization. He stated that a reduction in the insulation factor of safety will give a reduction in core loss and that a low core loss obtained in this manner may easily deceive a prospective customer who cannot be expected to be acquainted in detail with the strength of the various insulating materials and methods of using the same. In regard to the relation between efficiency and cost, it is to be noted that where the cost of energy is low a low-efficiency transformer is preferable to a higher-priced high-efficiency unit.

The merits of low-reactance transformers are frequently overstated. The higher the reactance the greater the ability of a transformer to withstand short-circuits. It is desirable, therefore, to have high reactance in transformers used in a large interconnected system.

Discussion.

Dr. C. P. Steinmetz stated that the paper by Mr. Hendricks contained a synopsis of the present knowledge relating to insulating materials and the methods of testing such materials. He called attention to the fact that, of all of the materials used in the construction of electrical apparatus, the insulation is by far the most important. In view of the advances that have been made recently in the production and utilization of insulating materials, it seemed desirable for the standardization committee of the Institute to specify more fully the characteristics of insulation and the methods by which these characteristics may be determined. In regard to the discrepancies found in the measured value of e.m.f. when a spark-gap in air is used for determining the voltage, Dr. Steinmetz expressed the opinion that these discrepancies can be attributed largely to transient phenomena which require considerable investigation. The voltmeter method of determining high-tension e.m.f. is very convenient, but since the voltmeter measures the effective rather than the maximum e.m.f. it is essential to utilize a sine wave e.m.f. with the voltmeter.

Mr. A. H. Pikler said that the paper by Mr. Hendricks was of much value in describing methods of testing insulating material in which a high degree of accuracy can be obtained. He stated that in insulating dynamo-electric machinery it is preferable not to depend upon fibrous materials except as a binder. The general requirements for insulation are the absence of moisture and the elimination of sharp corners on the conductors. For strictly insulating purposes a filler compound is better than an insulation of the layer type. When use is made of the voltmeter method of determining the testing e.m.f. it is essential to employ a transformer of low reactance if dependance is to be placed on an auxiliary voltmeter coil. This condition is rendered necessary on account of the fact that the voltmeter on the auxiliary coil measures the main magnetic flux, which may not indicate correctly the voltage on either the primary or the secondary coil when there is considerable magnetic leakage. Mr. Pikler expressed the opinion that Mr. Wooldridge should have specified all details of the tests of which he reported only the results, and should have mentioned the method used by him in separating the losses.

Mr. R. D. Mershon called attention to the fact that the voltmeter method of determining the testing e.m.f. had been found thoroughly reliable during the tests made at both Telluride, Col., and Niagara Falls, N. Y. He also stated that the auxiliary-coil method is a correct one to use provided the tests are conducted with the proper amount of care.

Prof. W. L. Puffer claimed that in determining the high-tension e.m.f. excellent results may be obtained by means of a static voltmeter connected across the high-tension coils.

Mr. E. W. Rice, Jr., mentioned the fact that in the construction of transformers an almost unlimited number of combinations of different dimensions, parts, coils, cases, cores, etc., can be employed. However, the multiplication of the number of different transformers is uneconomical, since by employing a lesser number of different units the aggregate cost may be considerably reduced. However, it is safe to say that at least 5000 different varieties of transformers have been produced in the factories of the General Electric Company.

Dr. A. S. McAllister called attention to the large variation in the exponent of eddy-current losses reported by Mr. Wooldridge, and expressed the opinion that the actual variation in loss was considerably less than that reported. The only known factor to which a change in the eddy-current loss could be attributed would be a small change in resistance, which would represent a correspondingly small variation in the coefficient rather than in the exponent.

Mr. L. T. Robinson stated that static hysteresis loops made upon the same silicon steel confirmed the value of the hysteresis losses reported by Mr. Wooldridge. For some reason it has been found impossible to predict the eddy-current loss from the known value of the resistivity of the silicon-steel sheets.

Mr. J. L. R. Hayden expressed the opinion that the variation in the eddy-current exponent reported by Mr. Wooldridge was due to inaccuracy in separating the eddy loss from the hysteresis loss. A slight change in the value assigned to the hysteresis loss would represent a large change in the eddy-current loss, on account of the relatively smaller value of the latter.

Prof. George F. Sever called attention to the convenience of a method of measuring the high-tension testing e.m.f. by means of condensers employed with a static voltmeter arranged somewhat according to the potentiometer method.

Mr. H. L. Schermerhorn expressed the opinion that in testing insulating materials use should be made of pieces larger than those employed by Mr. Hendricks. He suggested that standard sizes should be selected for pieces subjected to the testing e.m.f.

Mr. E. M. Hewlett stated that the A. I. E. E. standardization curve for the break-down voltage across a spark-gap in air should be extended up to at least 500,000 volts in order to cover the range of testing e.m.f. now employed.

Mr. William J. Foster described the various forms of generators which may be employed for producing sinusoidal e.m.f., including the old smooth-core alternator and the modern generator with distributed-field winding.

Upon motion of Dr. Steinmetz it was decided to refer the matter of standardizing the methods of high-tension testing to the board of directors of the Institute in order that it may receive proper attention on the part of the standardization committee.

TUESDAY EVENING SESSION.

The evening session on Tuesday, which was also held at the Mohawk Golf Club, was devoted to the presentation and discussion of four papers dealing with the general subject of high-tension transmission problems. These papers were written by Messrs. J. H. Cunningham, E. E. F. Creighton, G. Faccioli, and Messrs. E. I. Burkholder and R. H. Marvin. Abstracts of these papers and the discussions thereon will appear in a later issue.

TRANSFORMER DAY AND FINAL SESSION.

On Wednesday the convention was transferred to Pittsfield to afford the members an opportunity to visit the transformer factory of the General Electric Company and listen to the presentation and discussion of papers relating to transformer problems. Of the five papers presented, four dealt specifically with transformers and the fifth contained much information of value to transformer manufacturers and users. The transformer papers were presented by Messrs. F. C. Green, C. E. Allen, J. M. Weed, and Messrs. J. J. Frank and H. O. Stephens. The fifth paper was one by Dr. C. P. Steinmetz, entitled "Mechanical Forces in Magnetic Fields." Abstracts of these papers and the discussions will appear in a later issue.

The final technical session was held on Thursday morning at the Mohawk Golf Club. At this session papers were presented by Messrs. E. B. Merriam, entitled "Oil-Break Circuit-Breakers"; W. L. R. Emmet, entitled "Proposed Applications of Electric Ship Propulsion," and H. A. Laycock on "Voltage Regulation of Transformers." The subject of vector rotation was also briefly discussed.

OIL-BREAK CIRCUIT-BREAKERS.

In his paper on oil-break circuit-breakers Mr. Merriam stated that while the duties of an oil circuit-breaker are to connect, disconnect and isolate different parts of an electrical system, its most important function is to relieve the system of dangerous overloads or short-circuits which would otherwise prove disastrous to the service.

A distinctive feature of the oil circuit-breaker lies in the fact that when the alternating current which is maintaining an arc in oil passes through zero, at which point the electromagnetic energy is a minimum, the current is interrupted and remains so until the voltage rises to a sufficient value to puncture the insulating film of oil which has had time to flow in between the contacts.

A description was given of the auxiliary devices which render the oil switch selective in action and the conditions were stated under which it is advisable to use a non-automatic switch and when an automatic or a time relay one should be used.

Since the efficacy of an oil circuit-breaker depends, to a great extent, upon the quality and the condition of the oil, it is necessary to inspect it regularly to see that it does not become carbonized or for any other reason unfit for service. The subject of oil is very carefully considered and much valuable information is given regarding suitable dielectric strength and other requirements.

The rupturing capacity of an oil circuit-breaker depends upon several conditions, such as the velocity with which the contact part, the electrical characteristics of the circuit, the quality of oil used, the number and direction of breaks, etc. If the contacts move apart slowly the arc formed has time to become very violent and destructive. If the power-factor is less than unity the voltage is not in phase with the current and this makes it more difficult to squelch the arc.

The rupturing capacity of an oil switch is affected by the magnitude of the current, and hence anything which will reduce the current will diminish the work of the circuit-breaker. For this reason, and in order to limit the amount of energy which may be concentrated at any fault, the present tendency is to design generators with large internal impedance, thus limiting the maximum instantaneous value of the short-circuit current and permitting the use of oil circuit-breakers on systems of greater concentrated power than heretofore.

Discussion.

Mr. E. M. Hewlett claimed that it is highly advantageous to employ a time-limiting device with a circuit-breaker in order that the circuit may not be opened until the current has passed through its maximum flow and become sufficiently reduced by the lowering of the voltage of the generator.

Mr. L. C. Nicholson stated that almost any type of oil switch now upon the market will open its circuit without damage when called upon to do so for the first time. If thrown into the circuit at once and opened under load the chances are that the switch will be damaged, and if thrown in for the second time and opened for the third time it is very probable that the switch will be unable to operate successfully. He attributed these results to the carbonization of the oil. If sufficient time is allowed after each opening of the switch for the carbonized particles to settle in the bottom of the tank the oil returns to its former insulating condition and the switch operates without distress. He stated that from his own experience he has been led to conclude that a time lag in the opening of a switch of two seconds is better than any time lag of a less value.

Mr. W. L. R. Emmet said that oil switches as now built are as large as they should be constructed for the service for which they are intended. In order that they may perform their functions properly it is best to employ series reactance in order to limit the current under short-circuit conditions. He cited the case of a short-circuit in Chicago where twelve 12,000-kw generators had delivered current simultaneously through cables to a single short-circuit. These cables were ripped completely from the walls in which they were embedded and thrown out into the room.

Mr. R. D. Mershon expressed the opinion that the effect noted by Mr. Nicholson might equally well be attributed to a rise in temperature of the oil as to the carbonization of the oil. If the effect were produced by temperature rise the switch would return to its normal condition after a sufficient time interval, just as was found by Mr. Nicholson.

Mr. J. Barrow called attention to the fact that reactance inserted in series with a switch in order to limit the current changes the angle of lag of the current with respect to the voltage, and hence is not as advantageous as might seem at first sight, since for best opening conditions it is preferable for the e.m.f. and the current to reach their minimum values simultaneously.

Dr. A. S. McAllister stated that the disadvantage of having a reactance in circuit at all times, in order that it might be available for limiting the current when the switch opened, could be avoided by placing a short-circuit around the reactance to be opened by the relay device just prior to the opening of the switch itself.

Prof. W. S. Franklin expressed the opinion that distilled water, which has a high resistivity, might prove advantageous as a substitute for oil in circuit-breakers. When a water circuit breaker opens considerable steam would be produced, but this result need not be disadvantageous. He stated that the arcing formed at a switch might be sufficiently minimized by placing in parallel with the switch contacts a circuit consisting of a resistance in series with a condenser formed of aluminum cells, such as are used with lightning arresters.

Mr. C. F. Scott stated that one should not expect a switch designed for a small transmission system to take care of short-circuits produced in a very much larger system with which it is used several years later after the system has grown. Oftentimes switch failures can be attributed to the use of switches under conditions for which they were not originally intended.

Dr. C. P. Steinmetz remarked that the object of a switch is to protect the system, and it is not desirable to arrange for the system to protect the switch. He said that the spark around the switch can be minimized to any desirable extent by the use of a condenser, but that such a scheme may shift the burden from the switch to the system, and thereby produce the very damage which the switch is intended to eliminate.

Mr. H. L. Smith called attention to the desirability of consistency in the rating of switches. Considerable confusion exists at the present time by reason of the fact that no standard method is employed in the rating of switches intended for various purposes.

Mr. E. W. Rice stated that it would be undesirable for a switch to open instantaneously, even if such a result could be obtained. In a large electrical system continuity of service is

the prime requisite. In order to obtain continuity it is essential that when a single feeder is in trouble the switches on the other feeders and those on the generator should remain in circuit, while only the switch on the feeder in trouble opens. Thus, time limits must be employed with switches in large interconnected systems.

ELECTRIC SHIP PROPULSION.

In his paper on "Proposed Application of Electric Ship Propulsion" Mr. Emmet showed that a steam turbine designed for direct connection to the propeller shaft is very large, expensive and relatively inefficient, while a high-speed turbine is very simple in construction, small and highly efficient. It is desirable to employ some speed-reducing arrangement for allowing the turbine to operate at high speed while driving the propeller at low speed. One of the important advantages of electric propulsion as compared with other possible methods of speed reduction lies in the fact that arrangements can be made by which the ratio of the reduction is changeable so that the turbine may be run at its most effective speed under more than one condition of the vessel's operation. The possibility of such a change in speed ratio is particularly valuable in connection with warships since such vessels need very high speed for emergency conditions and also need to operate economically at low speed so that their radius of action may be made as wide as possible with a minimum dependence upon coaling stations. It will be seen that these qualities cannot well be combined in a ship whose propellers are driven directly by turbines, even if she is equipped with special turbines for cruising conditions.

For use with a certain battleship he suggested a 12,000-kw steam turbo-alternator and two motors, each rated at 7000 hp. The two motors would be coupled together into a single unit and connected to the propeller shaft. One of these motors would be of the induction type with squirrel-cage armature, the stator windings being so arranged that they could be connected either for thirty poles or for fifty poles, a suitable group of heavy toggle switches to effect this pole-changing being carried by the frame of the motor itself. The other motor would be of the type with a definitely wound rotor connected through slip-rings to external resistors of the water-immersed and water-cooled type. The resistors would be delivered directly to the sea water, which would freely circulate around the resistors.

Normally the ship would be operated at higher speeds with two generators and four motors, all of the motors having the thirty-pole connection. The turbine speed would then be reduced in the ratio of 7.5 to 1, the generators having four poles. When the speed became sufficiently reduced improvement of economy could be effected by disconnecting one of the generators and two of the motors, and when the speed had fallen sufficiently low a still further gain could be accomplished by connecting the remaining motors for fifty poles instead of thirty poles. With this change the ratio of reduction would be increased from 7.5 to 1 to 12.5 to 1, and a new cycle of favorable speed operation in the turbine would be begun.

Discussion.

Dr. C. P. Steinmetz described in detail the conditions imposed upon the propelling equipment used in the naval vessels. In order for the cruising area to be as large as possible it is essential that the cruising speed be maintained at the highest efficiency. Moreover, it is necessary to minimize the weight of the equipment in order that the maximum of fuel may be carried in the vessel. Thus, the primary requisites for cruising service are space, weight and operating economy. When a battleship is in action it is absolutely essential for it to operate at a speed which is much higher than the cruising speed. Under these conditions, however, efficiency in operation is of small importance compared with rapidity. Of all known prime movers the steam turbine is most advantageous for propelling battleships. However, it possesses two disadvantages, namely, its constant-speed characteristic and the high rotative speed which must be employed for proper economy. Therefore, when the steam turbine is employed it is necessary to make use of some speed-reducing and speed-varying mechanism. It is in connection with this service that the electrical equipment shows to such great advantage.

By means of a turbine-driven generator and directly connected motor the propeller shaft may be run at its highest efficiency during the cruising speed and may be controlled most conveniently for action during battle. Moreover, it possesses to the highest extent the characteristic of reliability under emergency conditions which must be maintained in naval equipments.

Mr. Gano S. Dunn compared the electrical propulsion of ships to the electrical operation of factories, and stated that it is not correct to confine the comparison to an efficiency basis. Experience has shown that the incidental advantages of electrical operation in factories more than compensate for any possible decrease in efficiency when the electrical equipment is inserted as an indirect link between the prime mover and the machines to be operated.

Mr. W. B. Potter remarked that the problems involved in electrical propulsion of ships are in many respects similar to those found in gasoline-electric cars. Seemingly, if the gasoline engine is to be used for propelling a car, it would be best to drive the wheels directly by means of the engine. However, it has been found highly desirable to allow the engine to drive a generator and the generator to supply energy to motors for propelling the car. When this arrangement is employed the engine operates at all times under its most efficient conditions, while the variation in torque at the different speeds is obtained most advantageously by means of the electric motors. The reliability of the gasoline-electric car is practically absolute so far as the electrical equipment is concerned, the only doubtful element in the equipment being the gas engine.

VOLTAGE REGULATION OF GENERATORS.

Much information relating to the methods by which automatic voltage regulators can be applied to direct-current and alternating-current generators was given in the paper by Mr. Laycock. Mention was also made of a special automatic device to be placed on an alternating-current system where heavy short-circuits are encountered. If the voltage regulator is employed and a short-circuit is experienced, the action of the regulator will tend to hold the voltage up and therefore give the exciter full field. Often in hydroelectric installations when this happens the water-wheel gates are wide open, full excitation is supplied to the exciters and generators, and if the short-circuit is suddenly relieved the voltage is likely to rise above normal value before the excitation can be reduced on the generators and exciters. The time required to reduce this excitation is the time taken by the generators and exciters to demagnetize their fields between maximum full field voltage and the voltage corresponding to the normal-load excitation, which may be from two to six seconds. This is augmented by the time required for the water-wheels to reduce the speed to normal. This can be overcome by placing overload and high-voltage relays in the transmission lines set so that should the current increase to a given value the relays will trip, open the connections to the regulator and reduce the voltage to a certain value (to be determined by the operating engineer) and after the short-circuit is burned off and the current becomes normal again the relays will close and the regulator will automatically be returned to service.

Discussion.

Mr. H. G. Reist explained that when an automatic voltage regulator is employed it is essential to make use of generators having a high degree of regulation, while by means of voltage regulators use can be made of any convenient type of generator quite independent of its regulating characteristics.

Mr. C. J. Fechheimer stated that in many types of alternators the cost depends largely upon the degree of regulation demanded. When a high degree of regulation is not required, the generator is much cheaper than otherwise would be the case, hence the installation of a voltage regulator results in a considerable decrease in the cost of generating equipment.

Mr. E. F. W. Alexanderson described several methods by which the voltage regulating characteristics of the generating equipment can be varied at will by slight mechanical changes in the operating mechanism of the voltage regulator.

VECTOR ROTATION.

In a short paper Prof. W. S. Franklin compared the clockwise and counter clockwise rotating vectors and stated that the counter clockwise representation does violence to the established convention as to the positive direction of rotation.

Prof. E. J. Berg, in a second short paper, stated that the crank diagram lends itself only to very expert mathematicians in case of polyphase circuits with distorted-wave shapes. For use with distorted waves the polar diagram is preferable to the crank diagram. The author claimed that the question of rotation does not enter since the rotation is counter clockwise in any case. In the polar co-ordinate system time rotates counter clockwise; in the crank diagram the e.m.fs. or currents are made to rotate counter clockwise.

On account of the lack of time the notes on vector rotation by Professors Berg and Franklin were not presented. A communication from Dr. Kennelly, who was responsible for initiating the discussion, was presented by Prof. C. A. Adams. Dr. Kennelly expressed the opinion that the polar-coördinate method of representation is excellent for determining the mean effective value of a distorted wave by means of a planimeter, but that it is disadvantageous when analyzing the harmonics of a distorted wave.

Professor Adams in his own behalf stated that the selection of the direction of rotation of vectors depends largely upon the habits of the person making the selection. The merits in the case are about equally divided between the two methods proposed. The selection of one standard method would, therefore, depend more largely upon the relative number of those who had formed the habit of using the separate methods than upon the relative merits of the methods proposed.

ENTERTAINMENT FEATURES.

The Pittsfield-Schenectady convention will long be remembered for the forethought expended in providing for the convenience of the visiting members and the thoroughness and promptness with which the arrangements were carried through. Between the morning and afternoon sessions held on Tuesday at the Mohawk Golf Club, Schenectady, an excellent lunch was served in the clubhouse, so that the visitors were afforded abundant opportunity for becoming acquainted and were relieved of the necessity of finding some convenient restaurant.

Wednesday being Pittsfield day, a Pullman train with diner attached for breakfast was provided for conveying the members from Schenectady and Albany to Pittsfield, where lunch was served at the works of the General Electric Company and dinner at the Hotel Wendell. The members were conducted through the works, where transformers and arc lamps were shown in all stages of manufacture.

On Thursday at the close of the final technical session electric cars were provided to convey the members from the Golf Club to the works of the General Electric Company, where lunch was served and the party was escorted on a tour of inspection through the factories. Both on Tuesday evening and Thursday evening corona effects were shown on the General Electric Company's experimental transmission line near Schenectady, while on Wednesday a 750,000-volt testing transformer was shown in operation in Pittsfield. The registered attendance was 325, about 25 per cent of whom were out-of-town members.

Proposed Ohio Public-Service Commission.

A public utilities bill has been introduced in both houses of the Ohio Legislature which covers all public service corporations with the exception of street railways and municipal plants. The bill fulfils a pledge in the Democratic platform, upon which the present Governor and the Democratic members of the Legislature were elected.

The present State Railroad Commission is to be transformed into "the Public Service Commission of Ohio," and, in addition to its present duties, it will have supervisory powers over all electric light, telephone, gas, heating, water and other similar corporations. The present commission has control over only steam and interurban electric roads. The bill gives the commission control over the issue of stocks and bonds. It can fix rates for service according to the tax value of the properties, and they can be increased only in proportion to the additional values listed in the tax returns. A fair rate is to be established in the beginning and the commission may increase it in case it is found that it is not sufficient to cover the necessities in the way of dividends, cost of operation, depreciation and improvements. All companies must have a depreciation fund. All companies must furnish a just and reasonable service and rates and charges that are not in compliance with the terms of the bill are to be taken as unlawful. No free service is to be given and no rebates, drawbacks or other considerations of the kind are to be allowed.

The plan of giving free service in competition with another company is prohibited. This practice was followed to some extent by telephone companies some years ago in Ohio, but not of late. Any change in rates requires a notice to the commission of thirty days, and, if allowed, a notice of thirty days must then be given the patrons. Complaints made by patrons must be investigated, but if a company makes complaint, a notice must be published in a newspaper in the city in which the business is located and ten days are allowed for such publication. The commission must then investigate the matter and make a ruling upon it. Companies must make such extensions and repairs as are ordered, an order of the commission being considered lawful in such cases.

In emergencies the commission may, with the consent of the company, temporarily suspend or alter rates. Full and complete information regarding new construction must be in the possession of the commission at all times and may require a separate accounting of the construction and operation. To be able to maintain a systematic record of all matters the commission shall fix standards of service and products of all the utility companies under its charge.

Officers of companies may be required to produce books and records, and may be compelled to testify at hearings. In case two companies are unable to agree upon a joint rate within a reasonable time, the commission may fix the rate and apportion it between them. Municipalities may, within a year of the expiration of franchises, fix a rate at which a utility company may operate, pending the granting of a new franchise; but, upon complaint of the company, the commission shall have a hearing, and, if it is found that the rate fixed is insufficient, unreasonable and will not yield a proper return, it may fix a fair and reasonable rate for the period fixed by the council. This rate shall be based upon the value of the part of the property used for the convenience of the people residing in the municipality, and be such as will give a fair return on the market value of the stocks and bonds. The ability to furnish service during that period must also receive consideration.

Utility companies cannot issue notes, stocks or bonds to run longer than twelve months without the authority of the commission, and the commission is not allowed to authorize such issues to reimburse expenditures from the income for betterments unless the accounts be kept in such a manner as to show clearly the purpose of the expenditure. A company cannot use the proceeds of an authorized stock or bond issue to refund short-term notes.

Authority cannot be given any company to capitalize its franchise for more than it actually paid to the municipality or other political subdivision for the grant, nor shall the capital stock of a consolidation exceed the combined capital stock of the companies interested and such additional sum as was paid in cash.

No contract for consolidation or issue shall be capitalized in the stock of any corporation, nor shall any corporation hereafter issue bonds as a lien upon any merger contract. Telephone companies, in order to consolidate, must have the

consent of the commission, and the same is true in the case of a lease or the purchase of the stock of one company by another. Before authority to do any of these things is given a hearing must be had and it must be shown that there are good reasons for the step.

In order that two companies with properties lying wholly or partly within the State may consolidate, it must be shown that the consolidation will be for public convenience and that adequate service will be furnished. In no case shall the aggregate amount of stock and debt of the consolidated companies be increased by this step. Orders of the commission may be enforced by mandamus proceedings brought by the Attorney-General, but no company will have power to bring injunction proceedings against the commission. An appeal may be taken to the Common Pleas Court and the orders of the commission may be stayed by that tribunal and finally may be modified or vacated entirely.

Salaries of the members of the commission shall be $6,500 per year each, but the annual expense of the department is limited to $90,000.

Proposed Public-Service Commission in Illinois.

A bill has been introduced in the lower house of the Illinois Legislature by Mr. Rawleigh to give the existing Railroad & Warehouse Commission jurisdiction over public utilities. The term "public utility" is intended to mean all corporations or individuals engaged in supplying telephone service or heat, light, water or power for public use. The bill is elaborate and provides for interchange of service between public utilities, uniform accounts, adequate depreciation, proper rates, standards and measuring instruments, testing of meters, public hearings, first-class service, protection from competition unless public necessity demands the second utility, "perpetual franchises" under the control of the commission, purchase of private plants by municipalities and other features of public-service regulation. It is similar to the law under which the Wisconsin Commission operates, but does not apply to any city having a population of 200,000 or more, thus exempting Chicago.

Perhaps this bill will not be passed, as it is reported that another bill, to represent the ideas of the State administration on public-service regulation, will be introduced. However, it is believed that a public-service commission of some sort is inevitable in Illinois and that the law creating it, if not passed at the present session of the Legislature, will be enacted at some succeeding session.

Massachusetts Legislative News.

The committee on public lighting recently gave a hearing on a bill providing that all issues of stock of gas or electric lighting companies shall be sold at public auction in Boston instead of being offered to stockholders at a price fixed by the board of directors, subject to the approval of the Massachusetts Gas & Electric Light Commission. Mr. G. N. Nichols, of Lynn, Mass., appeared on behalf of the bill, stating that it was based upon a recent statement of General Morris Schaff, of the Gas & Electric Light Commission, to the effect that new stock should be sold at auction to the general public. General Schaff stated at the hearing that he did not wish to interfere with the actions of boards of directors, and that he did not criticise dividends as high as 15 per cent under proper conditions, but he objected to the present plan of issuing stock at a substantial amount per share below the market price. Former Attorney-General A. E. Pillsbury appeared in opposition to the bill on behalf of the Massachusetts Gas Companies, and Mr. Everett W. Burdett appeared against the bill for the Massachusetts Electric Lighting Association. The opponents of the bill declared that if it were enacted it would take the State back to a system which had been discarded fourteen years ago and that the present system of jurisdiction by the Gas & Electric Light Commission amply protects the public. The point was made that the price of gas or electricity is the chief matter of interest to the public, and the price of stock as determined by the board of directors of a gas or electric light company can be set aside by the commission if in its judgment it is too low to be consistent with the public interest. The point was also brought out that the present method provides for an exhaustive investigation of the financial resources of the company by the commission; that this is practically always conducted at the hearings upon petitions for stock increases, and that there has resulted ample protection to the public interests.

New York Commission News.

The Public Service Commission, Second District, has received a joint petition from the New York Telephone Company and the Clifton Park Telephone Company for approval of the transfer of the plant of the Clifton Park company to the New York Telephone Company. The Clifton Park company operates in Jonesville, Saratoga County, and the territory immediately adjacent thereto. The company as a reason for its desire to transfer its plant states that as the New York company operates generally in Saratoga County, the plant can be more advantageously and efficiently used in connection with the system of that company. It is proposed to pay $4,365 for the property. A joint petition has also been received from the Ticonderoga Home Telephone Company and the Ticonderoga Telephone Company, asking for the approval of the transfer of a portion of the plant of the Ticonderoga company to the Home company. Both companies operate in the village of Ticonderoga, Essex County, and it is considered by both companies that a single system can be more advantageously and efficiently operated in that place. The Ticonderoga Home company proposes to pay $9,200 for the apparatus of the Ticonderoga company.

The commission will give a hearing this week on the application of the Delaware County Electric Light & Power Company, of Delhi, N. Y., for permission to issue capital stock, a mortgage and mortgage bonds, and for the transfer to it of the Delhi Electric Company. A further hearing will be held on the complaint of the Board of Aldermen of New York and various civic organizations of the greater city as to the interborough rates charged by the New York Telephone Company.

The Middleport Gas & Electric Light Company has asked for permission to exercise franchises granted for the furnishing of electricity for light, heat and power purposes in the town of Hartland, Niagara County, and the Wayne County Gas & Electric Company has petitioned for permission to exercise franchises for furnishing light in the village of Manchester, Ontario County, and the village of Newark, Wayne County.

The commission has received a complaint from residents of the incorporated village of Coxsackie, Greene County, directed against the Upper Hudson Electric Company, alleging excessive prices for electricity sold and delivered in that village. It is stated that the rate charged for commercial lighting in Coxsackie is 15 cents maximum and a minimum monthly charge of $1, and for street lighting $19 per incandescent lamp of 25 cp per year on the moonlight schedule. The complainants point out that the Upper Hudson Company, operating at Coeymans and Ravena, which are approximately ten miles from the generating station at Coxsackie, has charged for the past three years 6 cents maximum with no minimum monthly charge, and has offered to furnish street lighting to the unincorporated village of Ravena for $13 per lamp of 32 cp per annum, to burn all night long every night from dusk to dawn. The petition further points out that the Atlantic Light & Power Company charges but 12 cents maximum in Coeymans, Ravena and New Baltimore with a maximum monthly charge of 50 cents. For street lighting the charge is $20 per lamp of 32 cp for all-night service. The complaint has been served upon the Upper Hudson Company and an answer required within twenty days.

The commission has had under consideration an application by the Geneva-Seneca Electric Company to purchase the electric plant of J. Q. Howe's Sons at Phelps, N. Y., and a further application for approval of agreement of consolidation proposed to be entered into by and between the Geneva-Seneca Electric Company and the Wayne County Gas & Electric Company. Hearings have been had, and after investigation the commission has given preliminary consent to the consolidation of these several properties. Final approval is contingent upon the execution of the agreement of consolidation amended in conformity with suggestions made by the commission, upon the submission for approval of the first mortgage proposed to be executed by the consolidated company, and upon the filing of an amended petition correcting and supplementing the original petition in certain essential respects.

The Geneva-Seneca company supplies electricity in the City of Geneva and villages of Seneca Falls and Waterloo. The Wayne County Gas & Electric Company operates in the villages of Palmyra, Clyde, Newark and Lyons and supplies gas and electricity in each of these places, except in Clyde, where electric service only is furnished. The electric plant of J. Q. Howe's Sons is located in the village of Phelps, half way between the northern tier of the communities supplied by the Wayne County company and the southern tier in which the Geneva-Seneca company operates. With the completion of the consolidation project, it is planned to tie all these towns together for purposes of electrical distribution by the construction of a transmission line from Newark through Phelps to Geneva.

The commission has made an order requiring the Black River Telephone Company to appear before the commission to show cause why its manager published in a circular issued to the residents of Adams, N. Y., announcing a schedule of rates, the statement: "We wish to announce to you that the following rates for telephone service will become effective on Feb. 1, 1911, pursuant to an order of the Public Service Commission, Second District, Albany, N. Y." The increased rates are higher than the rates provided for in the franchise granted by the village of Adams, Jefferson County, to the Black River Telephone Company, and the apparent intent of the circular was to cause patrons to believe that the increase put into effect was due to the direct order of the commission. The company is also ordered to show cause why an order should not be made requiring the company to lower its rates in the village of Adams to the rates provided in the franchise under which it is operating in that village.

In various parts of the State there have been increases in telephone rates of companies under the jurisdiction of the commission, and in many places the commission finds that minor officers of these companies have attempted to place the responsibility for increased rates upon the commission. The commission is determined that the public shall not be misled by any such statements, and for this reason has caused a public investigation in the Adams matter, where a printed circular had been issued and distributed to telephone patrons. In no case has the commission ordered any company to increase its rates, and its sole efforts on the question of rates thus far have been directed to wipe out many discriminations existing in various parts of the State in which favored parties receive service at lower rates than their less fortunate neighbors do for like service.

Maryland Commission News.

Allegations charging the Diamond State Telephone Company with setting up excessive and discriminatory rates for telephone service within the town of Cambridge were filed with the commission by the Cambridge Board of Trade last week. The complaint alleges that the company is charging different rates for identically the same service to different residents of Cambridge.

The much delayed report of Prof. C. E. Munroe, of Washington, on the matter of a reduction in the price of gas and electricity was received last week. The report is a lengthy one and among the conclusions reached by Professor Munroe is that the Consolidated Gas, Electric Light & Power Company should be required to manufacture gas by the Kopper's gas oven method or by another method which would be equally efficient, as it would then be possible to sell gas at a lower rate. He also recommended that the London sliding scale be adopted, with proper modifications to meet local conditions, to the sale of gas in Baltimore. He further advocated that a concession should be made in the candle-power requirements, provided that the price of gas be reduced to 80 cents.

Canadian Hydroelectric Commission News.

At a meeting of the Ottawa (Ont.) Municipal Electric Commission, on Feb. 11, a large reduction in lighting and power rates was announced following a conference of the officials with Hon. Adam Beck and representatives of the Hydroelectric Commission.

Lighting rates are to be reduced (including the abolition of the meter charge) 19 per cent. Power rates for unlimited service are to be reduced from $25 to $23.40 per horse-power per year. For limited service the charge will be as low as $10.30 per horse-power per year.

For electric lighting hitherto the charge has been made entirely by meter at a rate of 8 cents per kw-hour. In future there will be a basic and fixed charge of 4 cents per month per 100 sq. ft. of area lighted, this being arrived at by taking the outside measurement of the house or building, including porches, verandas, sheds, outbuildings, cellars and unfinished attics, less 10 per cent allowance for walls, and multiplying that area by the number of stories in height. According to Mr. J. A. Ellis, secretary of the Municipal Commission, the charge of 4 cents per 100 sq. ft. is equivalent to about 3 cents per kw-hour. In addition to this charge there will be a meter rate of 3½ cents per kw-hour, less 10 per cent discount for prompt payment, no meter rental being charged. These prices are figured out to aggregate a rate of 6½ cents per kw-hour, instead of 8 cents as formerly. As a result of the announcement of these reductions it is anticipated that the Ottawa Electric Company will similarly reduce its charges to consumers.

CURRENT NEWS AND NOTES.

A. I. E. E. Annual Convention.—The exact date and place for the next annual convention of the American Institute of Electrical Engineers have as yet not been selected, but it has been decided to hold the convention in the Middle West late in June. The place will probably be Chicago or some summer resort in the neighborhood of that city.

Eiffel Tower Ready for Transatlantic Wireless.—After elaborate preparations, it is announced that the long-distance wireless telegraph equipment of the Eiffel Tower at Paris will soon be ready to communicate directly with New York City. Communication by wireless between Paris and Tunis and other points in Africa has now been an accomplished fact for several months.

Secretaryship of A. I. E. E.—The board of directors of the American Institute of Electrical Engineers has decided to submit to the membership the proposal to create an honorary secretaryship for life, with salary, for Mr. Ralph W. Pope, who has been elected secretary of the institute annually for the past quarter century. It will also ask the membership that the selection of the executive secretary be placed in the hands of the board.

Colorado Electric Club.—At the Thursday luncheon of the Colorado Electric Club on Feb. 16 the speaker was Mr. A. Dobbs, advertising manager for coco-cola, and the Adscript Club, of Denver, were guests, the total attendance being over 300. Mr. Dobbs' history of advertising and explanation of the present high plane of his vocation were very well received and formed a pleasant diversion in the usual technical talks.

Illuminating Engineering Convention to Be Held in Chicago.—On invitation of the Chicago Section of the Illuminating Engineering Society, the Chicago Association of Commerce and the Electric Club of Chicago the next convention of the Illuminating Engineering Society will be held in Chicago. The exact date has not been fixed, but the convention will be held probably late in August or early in September.

Institute of Operating Engineers.—On the evening of March 9 the Institute of Operating Engineers will hold the second of its monthly meetings in its rooms at the Engineering Societies Building, 29 West Thirty-ninth Street, New York. Prof. William D. Ennis, professor of mechanical engineering in the Polytechnic Institute of Brooklyn, will present a paper on the "Commercial Aspects of the Work of the Operating Engineer." Two other prominent engineers will be called upon to enter into the discussion of the paper. All interested are invited to attend the meeting.

Committees of Chicago Electric Club.—The chairmen of standing committees of the new administration of the Electric Club of Chicago are as follows; Membership, Mr. George H. Jones; house, Mr. A. L. Millard; speakers, Mr. C. A. Howe; entertainment, Mr. H. A. Mott; finance, Mr. W. R. Bonham; civics, Mr. John W. Mabbs. The full membership of the speakers committee is as follows: Mr. Howe, chairman, and Messrs. A. A. Gray, N. B. Parsons, J. R. Cravath, Frank F. Fowle, George C. Keech, James H. Delany, H. F. Holland, Ralph H. Rice, F. P. Vose, Frank L. Perry, George H. Lukes, R. S. Mitten, E. H. Noyes and Edward Wray.

Executive Committee of Independent Telephone Association.—At a meeting of the new board of directors of the National Independent Telephone Association, held at the office of the association in Chicago on Feb. 18, the executive committee was elected. It consists of Messrs. Frank H. Woods, Lincoln, Neb.; E. B. Fisher, Grand Rapids, Mich.; H. D. Critchfield, Chicago; Theodore Gary, Macon, Mo.; Walter J. Uhl, Logansport, Ind.; L. D. Kellogg, Chicago, and Richard Valentine, Janesville, Wis. The election of officers was postponed until the next meeting, to be held on March 10. Until then President Woods and the other officers hold over.

Revised Standard of Rubber Insulation to Be Enforced in Chicago.—Mr. William Carroll, city electrician of Chicago, has issued a notice saying that on and after April 1 the Department of Electricity of Chicago will not approve any rubber-covered wire that does not comply with the revised specifications of the Electrical Department of New York City. (See *Electrical World* of Feb. 2, 1911, page 318.) The specifications prescribe tests to be made on rubber-covered wire and are designed to raise the standard of rubber insulation. Mr. Carroll says that these specifications will exclude some of the rubber-covered wires on the market at the present time, and he asks for the co-operation of insulated-wire makers and dealers in the effort to raise the standard. Frequent tests will be made on the wire used in Chicago installations to determine whether they comply with the new specifications.

Chicago Section of Illuminating Engineering Society.—The program of future meetings of the Chicago Section of the Illuminating Engineering Society is as follows: March meeting, "Tests on the Lighting of a Small Room," by Mr. J. R. Cravath; April meeting, "Recent Improvements in Train Lighting," by the electrical engineer of the Chicago, Milwaukee & St. Paul Railway; May meeting, "Lighting of the People's Gas Light & Coke Company's Building in Chicago," by Mr. C. A. Luther, at a meeting to be held in the building described; June meeting, "Daylight Illumination." A local committee of three to co-operate with the general committee in making arrangements for the 1911 convention of the whole society, to be held in Chicago, has been appointed by Chairman Pearson, of the Chicago Section. It consists of Messrs. George C. Keech, J. C. D. Clark and John F. Gilchrist.

Contract Agents of Commonwealth Edison Company.—A meeting of the contract agents of the Commonwealth Edison Company, Chicago, was held on the evening of Feb. 14 at a Wabash Avenue restaurant, where the gentlemen in the party took dinner in a body. Mr. E. W. Lloyd, general contract agent of the company, presided, and addresses were made by Mr. George C. Keech, general sales agent of the Cooper Hewitt Electric Company, on "The Mercury-Vapor Lamp"; Mr. W. A. Durgin, assistant chief testing engineer of the Commonwealth Company, on "The Value and Methods of Light Measurement," and Mr. W. P. Lyon, of the contract department of the Commonwealth company, on "Practical Data on Illumination." Mr. John F. Gilchrist, assistant to the president of the Commonwealth company, also gave a talk, and there was an excellent musical program by employees of the company. Mr. Durgin's paper was illustrated by lantern slides and by demonstrations of light measurements by means of photometers and illuminometers.

Electricity at a Cement Show.—The fourth annual Chicago Cement Show was held at the Coliseum from Feb. 16 to 23. The most impressive feature of the show was the number of concrete mixers of various types, most of them shown in operation by being belted to small electric motors. To the electrical visitor it was of interest to note that the most conspicuous location in the center of the main floor was occupied by two of the handsome concrete lamp-posts such as are used in Lincoln Park and on the North Side bouvelards in Chicago to support arc lamps. These posts were described in the *Electrical World* some time ago. An interesting gallery exhibit consisted of the drawings accompanying the recent passenger subway report of Mr. Bion J. Arnold. Of purely electrical exhibits there were hardly any, unless exception is made in the cases of the Locke electric tile drill and the Schlueter electric floor surfacer. The former machine had never before been shown in the West. It is made by the Locke Tile Drill Company, of New York, and consists essentially of a small electric motor connected by means of a circular cam, ball bearing, floating ring and a spring to a percussion drill.

N. E. L. A. Commercial Section Membership Campaign.—A sterling-silver loving cup, 10 in. in height, has been donated by Mr. J. Robert Crouse for presentation to the person who shall succeed in securing the greatest number of new members for the Commercial Section of the National Electric Light Association before May 15, 1911. Mr. Crouse is chairman of the membership committee, its other members being Messrs. Edward E. Bailey, Napoleon H. Boynton, Charles D. Burleigh, Duncan Campbell, W. R. Collier, I. W. Dixon, I. D. Gibbs, L. D. Mathes and J. C. McQuiston. Large posters, embellished with a full-sized reproduction of the cup and giving the conditions of the contest, will be sent to the principal central stations and electrical manufacturers of the country and the committees hope that these posters will stimulate immediate interest in membership among the employees who will read them. About 200 men have already been enrolled in the contest, and one may enter for the prize by registering with Mr. Crouse and asking for campaign material. The large number of contestants from the larger central stations—as many as eight in one case—has introduced another element of chance by which the smaller central station or manufacturer may carry off the cup. Mr. Crouse's address is 1823 East Forty-fifth Street, Cleveland, Ohio.

Coming Iowa Convention.—In calling attention to the convention of the Iowa Electrical Association to be held in Davenport on April 19-21 the secretary notes that the Coliseum, where the convention will be held, presents a clear floor space of 100 ft. x 175 ft. There will thus be ample space for exhibits.

Ice Machines in Minnesota.—Four artificial ice machines to be operated electrically from the lines of the Albert Lea Light & Power Company have recently been sold in Albert Lea, Minn., to large ice users. This is in spite of the fact that the ice crop never fails in Minnesota and the town is situated alongside a large lake from which ice can be harvested.

Lignite Coal in Alberta.—The Dominion Geological Survey, in a special bulletin, announces the presence of a valuable lignite coal area at Edmonton, Alberta, fourteen miles in extent and estimated to contain 80,000,000 tons. The report states that this coal used in the gas-producer of the down-draft type is more economical for power production than the best grade under the steam boiler.

Canadian International Waterways Commission.—The Canadian Section of the International Waterways Commission will be appointed as soon as legislation giving effect to the new treaty is passed and salaries provided. It is learned that Sir George C. Gibbons, of London, Ont., has been tendered and has again accepted the chairmanship of the body, but the other members have not yet been determined upon.

West Virginia Independent Telephone Association.—The West Virginia Independent Telephone Association will hold its fifth annual convention on March 23 and 24, 1911, in the City of Clarksburg, W. Va., with headquarters at the Waldo Hotel. The main social feature will be a smoker on the evening of the 23d. Mr. R. M. Dalzell, secretary, Wheeling, requests that manufacturers secure hotel accommodations early, as a fire recently destroyed one of Clarksburg's big hotels.

Wireless Experiments on Union Pacific Trains.—Before the New York Railroad Club, Feb. 17, Dr. Frederick H. Millener, of Omaha, Neb., described experiments conducted by the Union Pacific Railroad for equipping its trains with wireless telegraph outfits. Portable-type sets installed in the baggage cars were used, and for emergency aerials ordinary steel-ribbed umbrellas have been employed as antennas. Operators on moving trains have been able to communicate with signal towers and other trains at distances of from 500 ft. to thirty-five miles. A number of prominent railway men attended the meeting.

Special Train to Houston Convention.—If seventy-five reservations can be secured a special train will be run from Dallas to Houston, Tex., for the convention of the Southwestern Electrical and Gas Association to be held in Houston April 27-29. It is proposed to leave Dallas on the Houston & Texas Central at 11 p. m. on April 26, arriving in Houston at 7 a. m. the next day. Delegates from New York, Chicago and St. Louis are asked to leave St. Louis at 9 a. m. on April 25, arriving in Dallas the next morning and spending the day in that city. Mr. D. G. Fisher, 300 Commerce Street, Dallas, Tex., is secretary of the association.

Iron-Rail Telephone Poles on the Isthmus.—Construction work on the permanent telephone line along the relocated Panama Railroad, Isthmus of Panama, is now proceeding between Caimito and New Frijoles, and as soon as that section is completed the building of the line between Gatun and Monte Lirio will be begun. It is interesting to note that old steel rails 28 ft. long are used for poles. These rails are set in concrete bases, the amount of concrete in the bases varying according to the character of the ground, the swampy sections requiring heavier foundations than elsewhere on the line. The concrete base has been a valuable adjunct in iron-pole construction on the Isthmus. It has served not only to prevent rusting, but it makes a strong construction for which bracing is unnecessary.

Tragic Result of Latter-Day Journalism.—While endeavoring to procure evidence that Cook County was being defrauded in coal deliveries a reporter for one of Hearst's Chicago daily newspapers managed to get in a position in one of the substations of the Chicago Sanitary District where he could look unobserved on an alleged payment for coal not actually received. The substation in question is located on the grounds of the Cook County Hospital and the reporter wanted to observe while remaining unseen what was going on in the adjoining weighmaster's room. He succeeded in getting into a position in the substation where it was supposed that no human being would venture, but in doing so came in contact with 12,000-volt primary connections of a transformer and was instantly killed. An assistant engineer tried to recover the body of the unfortunate newspaper man and was also killed.

Theft of Electricity in St. Louis.—According to the St. Louis *Star*, J. H. Long, proprietor of a poolroom at 506 North Fourteenth Street, St. Louis, was fined $50 and costs, amounting in all to $66.45, in Judge Miller's court on Feb. 3 for stealing electricity from the Union Electric Light & Power Company. Long pleaded guilty, and the sentence in his case is said to mark the beginning of a determined effort on the part of the company to break up the practice of stealing electrical energy, which is known or suspected to exist in numerous instances. In Long's case a "jumper" was arranged around the meter so that energy could be taken from the service wires without being measured. Long denied that he placed the jumper in position, but admitted that it was found in use and that he would have to take the consequences. It is thought that the amount of the fine and costs was many times the value of the electricity obtained without payment.

Manhood Engineer.—In recent years the word "engineer" has come to be used in many senses foreign to the original significance, as exemplified by such titles as sales engineer, advertising engineer, commercial engineer, industrial engineer, efficiency engineer, publicity engineer, production engineer, etc. The latest addition to the list is suggested by an article in a college publication the writer of which says he desires "to call the attention of university men to the fact that there is a profession of "manhood engineering," that this profession is well beyond its experimental period, and that it offers scope for a life work." From the article it would appear that the Y. M. C. A. has started a movement toward establishing fellowships in colleges for the training of secretaries for conducting its work, and that the term "manhood engineering" is applied to the course of study and also to the new profession that will be created. To the fellowship is attached a salary of $500 per annum during the two years of incumbency.

Lakes-to-the-Gulf Waterway.—The board of government engineers appointed by President Taft and headed by Gen. W. H. Bixby has made its report to Congress on the project of constructing a waterway along the Desplaines and Illinois Rivers to connect the present terminus of the Chicago Drainage Canal with the Mississippi River, thus forming an important link in the Lakes-to-the-Gulf waterway project. The commission reports that a waterway not exceeding 9 ft. deep from Chicago to the mouth of the Illinois River is entirely feasible. The section of the channel between Lockport, Ill., the western terminus of the Chicago Drainage Canal on the Desplaines River, and Utica, Ill., the head of navigation on the Illinois River, can be constructed for less than the $20,000,000 the expenditure of which has already been approved by the voters of Illinois. If the waterway is built the State should transfer to the federal government the locks and control of the channel so far as it relates to navigation, the State of Illinois retaining the ownership and control of the water-power rights.

ELECTRIC SERVICE AROUND CHICAGO.

Generation, Transmission, Distribution and Sale of Electricity by the North Shore Electric Company.

SURROUNDING Chicago completely on the north, west and south, the territory served by the North Shore Electric Company is large and varied, and the operations of the company in this suburban area present many peculiar and interesting problems that are well worthy of study. The territory served includes practically all of Cook County outside of Chicago, all of Lake County and parts of McHenry, Kane, DuPage and Will Counties. The total area served is approximately 1284 sq. miles, with an estimated population of 250,000, and is about eighty miles long from north to south with an extreme width from east to west of about thirty-two miles. This extensive region covers wide areas of farm lands, but also includes seventy-one incorporated cities and villages to which electricity is furnished. The largest city on the company's lines is Evanston, bordering Chicago on the north, with a population of about 25,000, while the smallest village is Rondout, with a population of 100. Of the entire population of 250,000 in the territory it is estimated that about 160,000 people live in the cities and villages. The company supplies alternating current for all purposes within this area. Fig. 2 is a map showing the territory served and also the generating stations, substations, cities and villages and transmission and distribution lines. The main office is in Chicago.

The character of the population in this territory is varied. The residential suburbs of Chicago contain well-to-do people and others of moderate means doing business or employed in the large city. There are also a number of manufacturing cities and villages in which are located the plants of companies having offices in Chicago. The farming districts include areas devoted to truck farming and dairy farming, as well as general farming country, and, in the northern part of the territory particularly, there are a number of large country places used as summer residences by "gentlemen farmers."

Of the seventy-one cities and villages now served by the company twenty-two were served formerly by eighteen local companies operating non-condensing steam plants rated at from 50 kw to 500 kw. In only one or two towns was there any attempt to furnish twenty-four-hour service or to supply electricity for motors. Of these plants the only one remaining in operation is the Evanston station, which is a combined hot-water-heating and electric light plant, and which has been remodeled since it was taken over by the North Shore Electric Company. At the present time twenty-four-hour service is furnished in all territory supplied by the company. Electricity is sold to three railway companies as well as to commercial customers, and the company supplies water for domestic purposes from pumping stations in LaGrange and Harvey and hot-water central-station heating in Evanston and Waukegan. All told, the number of electric light and power customers is 16,000, while there are 2500 customers for water and 200 for heating. The company has street-lighting contracts in forty-six communities, and 1800 series-tungsten and 1500 series-arc lamps are installed for this purpose. The connected load amounts to 15,000 kw for lighting, 9000 kw for general power and 4500 kw used for railway service.

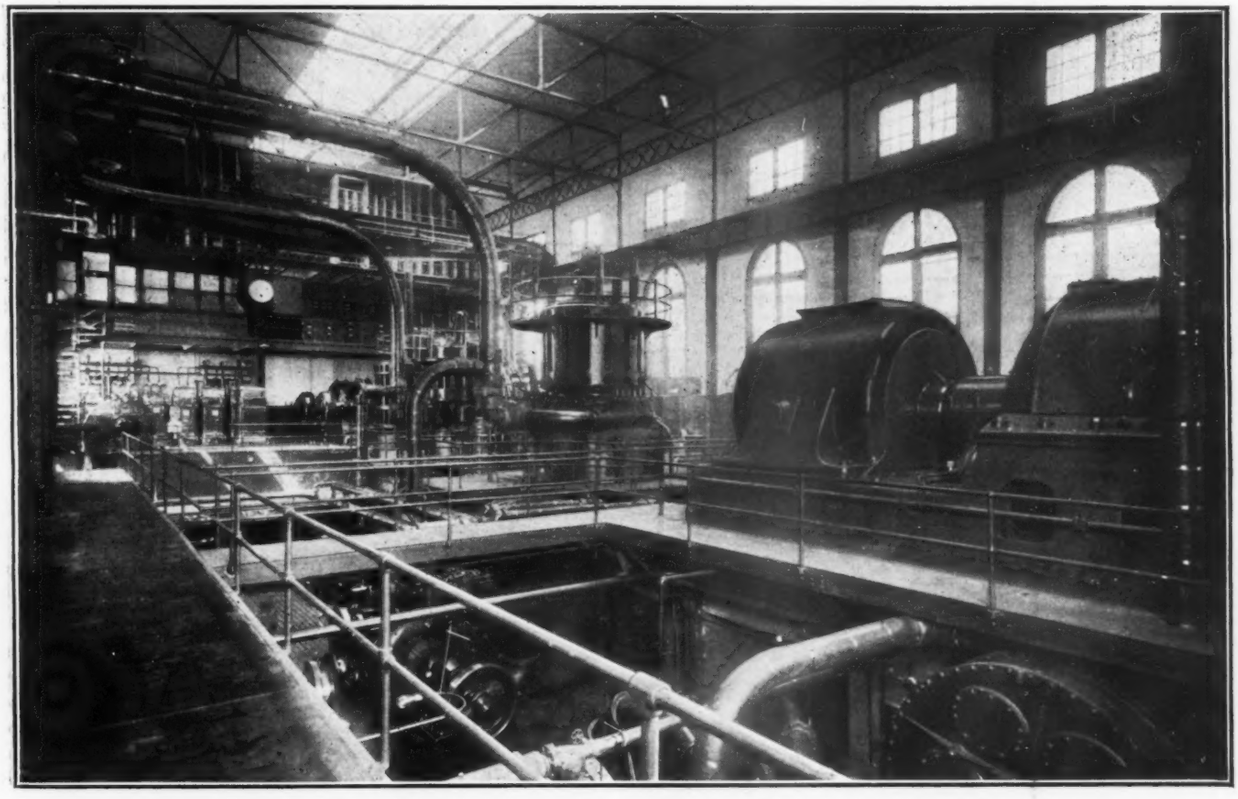


Fig. 1—Interior of Blue Island Generating Station of North Shore Electric Company, Near Chicago.

GENERATING STATIONS.

Four generating stations supply electricity to this extensive territory. The station at Waukegan is rated at 4000 kw, that at Evanston at 700 kw, while Maywood and Blue Island have a rating respectively of 2250 kw and 7000 kw. The location of these stations is shown on the map, Fig. 2. The largest is at Blue Island, and Fig. 1 represents the interior of this station, while Fig. 3 is an exterior view. An extension to this station which will double its size is under construction.

Owing to the fact that the company supplies not only 60-cycle energy for general lighting and power, but also sells 25-cycle energy in large amount to interurban railway companies it was necessary to install in two of the generating stations, those at Waukegan and Blue Island, generating units of each frequency. In the Waukegan plant the 60-cycle equip-

ment consists of one 500-kw, 2300/4000-volt vertical turbo-generator, one 1000-kw, 2300/4000-volt vertical turbo-generator and one 2500-kw, 25-cycle, 9000-volt horizontal turbo-generator. In order to tie together the 25-cycle and 60-cycle systems a 1000-kw frequency changer was installed at this station.

At the Blue Island station the 60-cycle energy is supplied by a 4000-kw, 60-cycle, 12,000-volt horizontal turbo-generator. The 25-cycle units consist of one 1000-kw, 9000-volt, 25-cycle vertical machine and one 2000-kw vertical unit. A 2000-kw vertical frequency-changer set is here installed. The 25-cycle end of this machine is wound for 9000 volts and the 60-cycle end for 2300/4000 volts, step-up transformers being used to raise the voltage to 12,000 volts. Up to the present time all 25-cycle units installed by the company have been wound for

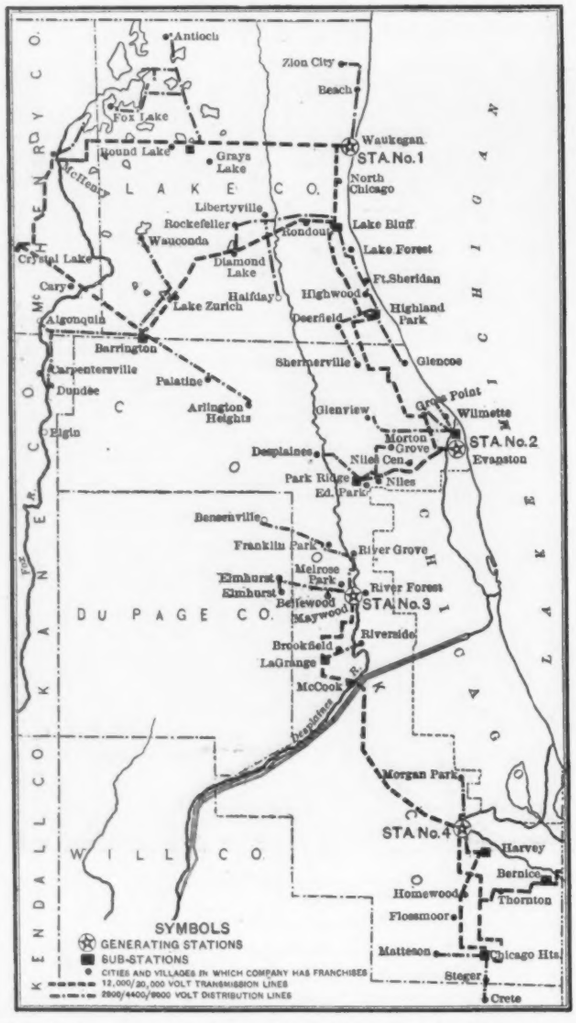


Fig. 2—Map Showing Transmission Lines and Territory Served.

9000 volts, thus conforming to the existing 9000-volt system of the Commonwealth Edison Company of Chicago, with which the North Shore Electric Company maintains harmonious relations. Most of the 60-cycle generating units installed by the company are wound for 2300/4000 volts, the exception being the 4000-kw horizontal turbo-generator at the Blue Island plant, which is wound for 12,000 volts on account of the fact that the greater portion of the 60-cycle output of this station is transmitted to a distance on 12,000-volt lines.

At the Blue Island generating station the busbars are all located in an air chamber in the basement and are inclosed in brick compartments. Disconnecting switches with brick barriers between them are mounted in this busbar compartment and the wires are brought from them directly to the terminals of motor-operated oil switches, which are placed on the floor above. All of the switching apparatus is electrically operated and is controlled from a benchboard located in a gallery at one end of the station.

The exciter system consists of one 70-kw generator direct-connected to a 440-volt induction motor, one 50-kw machine direct-connected to a steam engine, one 100-kw unit direct-connected to a steam turbine, two 42-kw exciters direct-

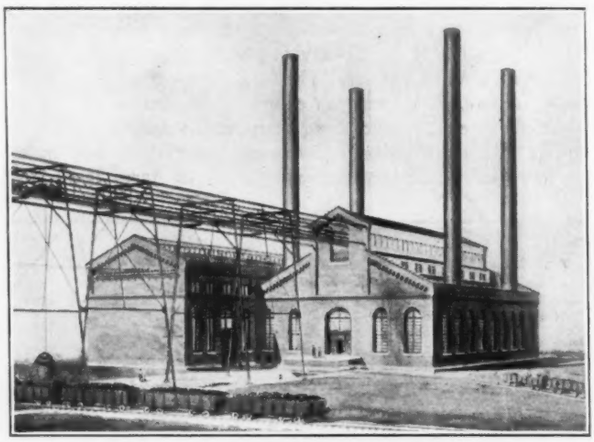


Fig. 3—Blue Island Generating Station.

connected to two 500-kw frequency changers and one 100-kw exciter direct-connected to the 2000-kw frequency changer. The switching arrangement for all of the exciters is such that any number of them may be cut in on either of two buses, one of which is used for 25-cycle and the other for 60-cycle excitation.

The auxiliary motors at the Blue Island station used for cranes, coal crushers, stokers, etc., are all of 440 volts and represent a connected load of about 300 hp. They are supplied from a three-phase, 25-cycle transformer stepping down from 9000 volts to 440 volts.

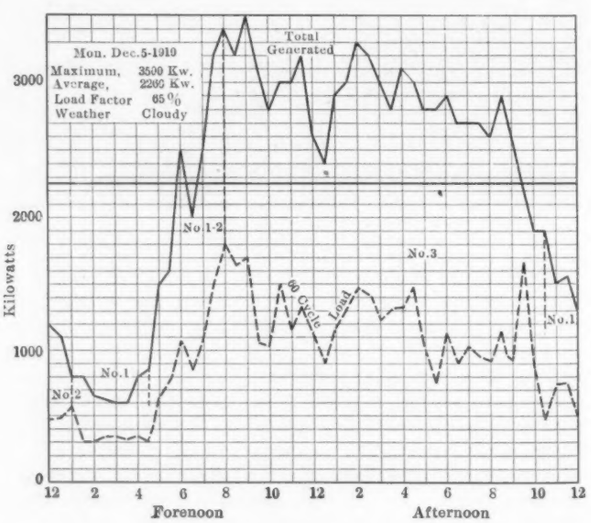


Fig. 4—Typical Load-Curve of Blue Island Generating Station.

The output of the Blue Island station is used for lighting, industrial motors and railway service. Fig. 4 is a typical load curve for this station, showing the total load generated in the upper curve and the 60-cycle load on the lower dotted line. This diagram represents the load on Dec. 5, 1910.

The Maywood station supplies 60-cycle energy only, the generating units in this station being wound for 2300/4000 volts.

TRANSMISSION LINES.

About 150 miles of 12,000-volt and 20,000-volt, three-phase, 60-cycle transmission lines are operated by the company. To these lines are connected about 2000 miles of 2300/4000-volt distribution lines and about forty miles of 4600/8000-volt distribution lines.

A standard type of construction for 12,000-volt and 20,000-volt transmission lines has been adopted. As practically all of

Fig. 5—Typical Two-Circuit, 20,000-Volt Transmission Construction, with Secondary and Telephone Lines.

the territory covered by the transmission lines is also supplied with local service requiring 4000 volts, it has been found advisable up to the present time to use wooden poles exclusively. Each transmission-pole line is intended to carry two three-phase transmission circuits arranged in a triangle, one circuit on each side of the pole.

Fig. 5 is a reproduction of a photograph showing typical construction for two 20,000-volt transmission lines. A four-pin arm is placed in the upper gain in order to allow the temporary use of this cross-arm for a single circuit, the three wires being arranged in a horizontal plane. Fig. 6 shows the typical construction for one transmission line. The spacing between the wires is 30 in. The insulators are of the 33,000-volt porcelain

Fig. 6—Three-Phase Transmission Line, with Secondary and Telephone Circuits.

type and are mounted on steel pins. The gain for the 4000-volt cross-arm is spaced 5 ft. below the lower transmission line. A cross-arm for the company's telephone wires is attached 5 ft. below the 4000-volt cross-arm. Up to the present time the need of a ground wire for lightning protection has not been felt, although such a ground wire may be added if necessary. Transmission lines are protected at the stations and substations by lightning arresters either of the multi-gap or aluminum-cell types, all 12,000-volt and 20,000-volt arresters purchased within the last two years being of the latter type.

In Fig. 5 the two 20,000-volt transmission lines are shown on the two cross-arms at the top of the pole. Lower down is the cross-arm for local service, while beneath that again is the telephone cross-arm. Fig. 6 is similar, except that only one transmission circuit is provided at the top of the pole, and therefore only one cross-arm is needed for this purpose. Fig. 7 shows a typical transformer installation on a pole, the transformers being used to supply energy for industrial motors.

Two standard voltages have been adopted for 60-cycle transmission—that is, 12,000 volts and 20,000 volts. All transformers are wound so that they can be operated on either 12,000 volts or 20,000 volts. As previously mentioned, the company sells electricity to three interurban electric railways. Two of them buy 25-cycle energy at 9000 volts, 13,200 volts and 33,000 volts. They own and operate their own transmission lines and the energy is delivered to them and measured at the power-house switchboard. The third railway buys 60-cycle energy at 12,000 volts, the electricity being measured and delivered to this railway company at the Indiana State line.

Connection is made with the system of the Commonwealth Edison Company at three points—Blue Island, Evanston and Maywood. The 25-cycle, 20,000-volt underground-transmission "ring" of the Commonwealth Edison Company loops through

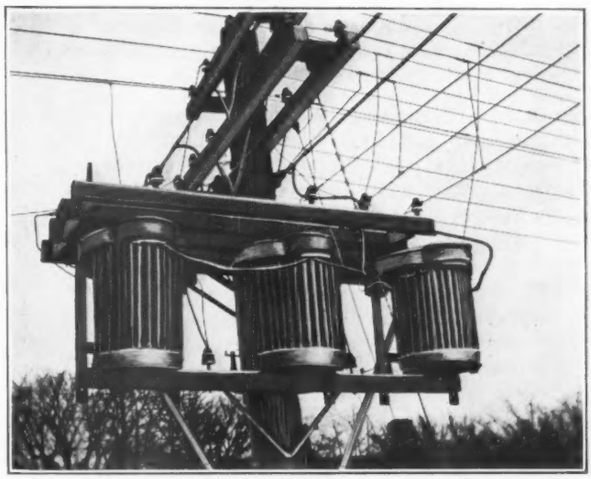


Fig. 7—Typical Transformer Installation on Pole for Industrial Motors.

the Evanston substation of the North Shore company and here transformers are installed stepping the voltage down to 9000 volts for the frequency changers and 13,200 volts for supplying the transmission line leading to the Winnetka substation of the Chicago & Milwaukee Electric Railway. At Blue Island connection is made by means of two combination overhead and underground transmission lines extending from the Blue Island station to the Roseland substation of the Commonwealth company. One of these lines is operated at 20,000 volts and is tapped into the Commonwealth high-tension "ring" at this substation. The other line, an auxiliary line, is operated at 9000 volts. At Maywood a 4000-volt, 60-cycle connection of limited capacity is maintained by the Commonwealth system for break-down service.

Two supply lines are provided for each important substation, so that one may be used in the event of interruption of service on the other. A reference to the map (Fig. 2) will show how this plan has been carried out. The "ring" system of transmission has been freely used, and wherever possible two sources of energy are connected to each ring. This plan involves a considerably larger investment than would be otherwise needed, but it is believed that it is warranted under the conditions, as it not only results in shorter interruptions of service, but facilitates and renders less dangerous the maintenance of transmission lines.

DIVISION OPERATION.

On account of the radial distribution of population around Chicago along steam-railroad lines, the system of the North Shore Electric Company naturally divides itself into three main divisions. The first division comprises the portion north and northwest of Chicago. This receives its supply of energy from the Waukegan and Evanston generating stations and also some from Chicago. A 20,000-volt overhead transmission line

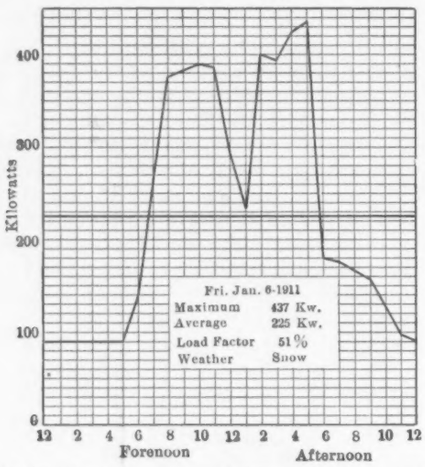


Fig. 8—Typical Load-Curve of Harvey Substation (Motors and Small Lighting Load).

extends from Evanston to Waukegan and loops through the Highland Park and Lake Bluff substations. A 20,000-volt transmission line in the form of a loop extends from the Waukegan station west through Gray's Lake to Barrington, thence back to the Lake Bluff substation, where it taps the main transmission line. A separate transmission line, about ten miles long, extends west from Evanston to the Park Ridge substation. The electrical operating headquarters for this division are located at the Evanston substation. The division chief operator acts as load dispatcher and is in constant touch with

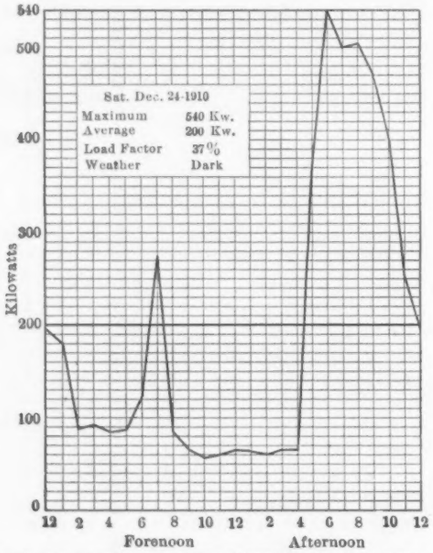


Fig. 9—Typical Load-Curve of Highland Park Substation (Almost Exclusively Residence-Lighting Load).

all switchboard operators and the load dispatcher of the Commonwealth Edison Company over the private-telephone system maintained by the company.

The second division lies west of Chicago and is supplied from the Maywood generating station. A 12,000-volt transmission line extends from the Maywood power house to the LaGrange substation, which is a combined lighting and pumping substation. A transmission line from the Blue Island power house to the LaGrange substation, forming a link between Maywood and Blue Island, will shortly be put into service. The Maywood plant is the operating headquarters for this division, and the chief engineer of the station acts as load dispatcher.

South of Chicago is the third division, which is supplied from the Blue Island station. From this generating plant duplicate transmission lines extend to the Chicago Heights substation and duplicate 4000-volt tie lines extend to the Harvey substation, which is a combined lighting and pumping substation. The operating headquarters for this division are located at the Blue Island station. The chief engineer of this station acts as load dispatcher and is in touch with both the Commonwealth Edison load dispatcher and the North Shore substation operators through private telephone lines maintained by the North Shore company.

SUBSTATIONS AND DISTRIBUTION.

The list of substations, with their ratings and in some cases special characteristics, is as follows: Lake Bluff, 450 kw; Highland Park, 1200 kw; Park Ridge, 500 kw; Barrington, 525 kw; LaGrange (lighting and pumping), 825 kw; Harvey (lighting and pumping), 300 kw; Chicago Heights, 1800 kw; Gray's Lake, 250 kw; Evanston, 2400 kw (frequency-changer, 1500 kw, and transformer, 900 kw).

As intimated previously, the usual local distribution is a 2300/4000-volt, four-wire, three-phase system. Single-phase

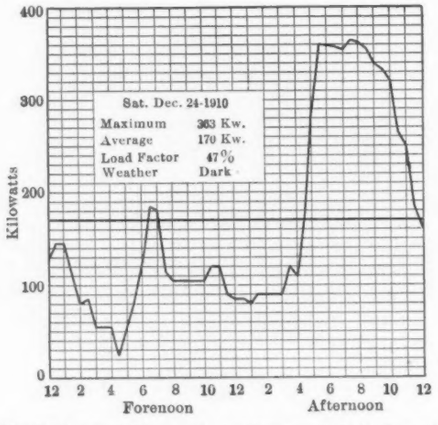


Fig. 10—Typical Load-Curve of LaGrange Substation (Pumping, Lighting and Some Motor Load).

lighting is supplied from one phase of the four-wire system and energy for motors in excess of 7½ hp is supplied from the three-phase system.

The company has adopted the plan of stepping up the voltage on certain long feeders from 2300/4000 volts to 4600/8000 volts. This is done by means of compensators or boosters in the substation. Special transformers are used on the line, and they are wound with primaries for either 2300 volts or 4600 volts and secondaries of 115-230 volts. Wherever these 8000-volt lines enter thickly settled communities the voltage is stepped down by means of transformers on poles from 4600/8000 volts to 2300/4000 volts.

For the convenience of customers and the maintenance of proper relations with the various municipalities served, the territory is divided into seven districts, with a district office located at some convenient point in each district in charge of a district superintendent. The company work in each district is carried on through various departments, such as those relating to inspection, distribution, meters, inside wiring, contracts, accounting, stores, etc., the head of each department reporting to the district superintendent. The district superintendent in turn reports to the vice-president of the company in Chicago on matters of general policy and to the other general department heads in the main Chicago office on matters pertaining to their respective departments.

The substations supply electricity for varied purposes. This is well indicated by the three typical load curves which are

given herewith. Fig. 8 shows the load on the Harvey substation on Jan. 6, 1911. A very large proportion of the output of this substation is used by industrial concerns, and this fact is clearly shown in the double peak.

Fig. 9 shows load curve on the Highland Park substation. This supplies almost altogether a residence district, although there is a small amount of electricity used for motors. The great dominance of the evening lighting peak is clearly indicated by this curve.

Fig. 10 is a curve showing the load on the LaGrange substation on Dec. 24, 1910. This substation is of particular interest because it is also a pumping station, and the curve indicates the characteristics of an output of a station supplying electricity for pumping, lighting and some motor load.

Fig. 11 is an illustration showing the exterior of a typical substation building, that at Evanston being selected. Fig. 12 shows the interior of the LaGrange pumping substation and Fig. 13 is a view of the switchboard in the LaGrange substation.

The LaGrange substation is particularly interesting in its combination of water-works pumping and central-station service. It was described in an article published in the *Electrical World* of Feb. 2, 1907, page 240. Horizontal centrifugal pumps and deep-well centrifugal pumps are used. Since that article was published another artesian well, 2100 ft. deep, has been added to the water-works equipment. The diameter of this well for a distance of 250-ft. below the surface is 15-in., reduced successively at greater depths to 10 in., 8 in. and 6 in. For the operation of this well there has been installed a third deep-well pump similar to those described in the article previously published. In addition one of the two 350-gal. horizontal pumps previously described has been replaced by a new pump having a rating of 750 gal. per minute.

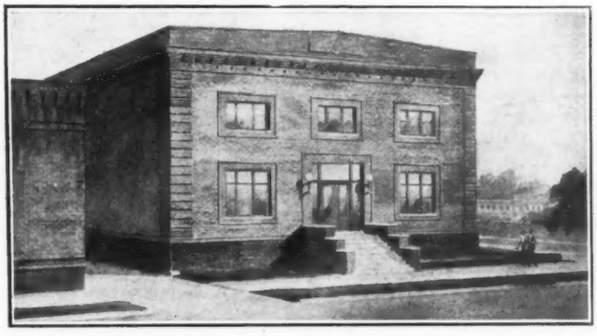


Fig. 11—Evanston Substation of North Shore Electric Company.

Fig. 14 is a wiring diagram of a typical transformer substation of the North Shore Electric Company. Solid lines represent three wires or three pieces of apparatus of the same kind. Dot-and-dash lines represent a single wire or bus, while dotted lines represent future work.

Starting with the 20,000-volt, three-phase transmission lines, which are either feeding the substation as a link of a high-tension transmission loop or high-tension feeders for large customers, these lines enter the building either through the roof using a combination of porcelain and fiber bushings or through the wall through special line entrances made up of bituminous fiber conduits. In some cases when the horn-gaps for electrolytic lightning arresters are mounted on the roof of the building, while the tanks for the arresters are mounted inside of the building, the line as well as the taps of the lightning arresters comes through separate entrances. However, it has been found preferable to mount horn-gaps inside the building whenever space permits, as the horn-gaps have to be operated each time the lightning-arrester films are reformed.

From the line-disconnecting switch the energy passes through choke coils and current transformers to the oil switch. The oil switch mostly in use is a K-6 General Electric type. This is a high-voltage switch, but of a lighter capacity than the H-3. The K-6 oil switch is top-connected, while the H-3 oil switch, which will have to replace the K-6 when the capacity of the system increases, is a bottom-connected switch. The substation is designed, however, so that one type can be substituted for another type without much work and without spoiling the appearance of the layout. The oil switch is connected to the bus through a disconnecting switch mounted on the same concrete compartment which incloses the bus. The 20,000-volt bus is amply provided with bus-disconnecting switches, so that any desirable combination can be made for splitting the bus.

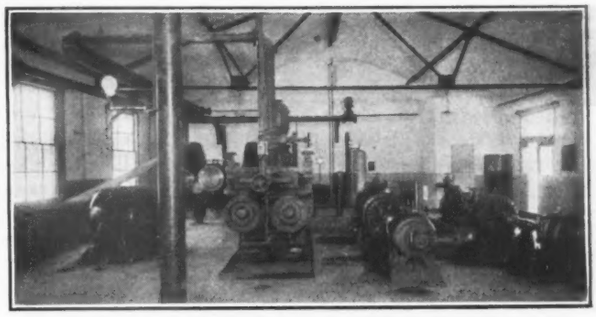


Fig. 12—Combined Pumping and Substation at LaGrange.

After passing through the K-6 oil switch the energy passes to the transformers, which step down from 20,000 volts to 2300/4000 volts with the neutral grounded. Only single-phase transformers have been used so far because few substations demand more than two banks of transformers, in which case it is cheaper and safer to use single-phase than three-phase transformers. The transformers are connected to the 2300/4000-volt distribution bus through K-2 oil switches. The 2300-volt bus is in most cases a single bus with an auxiliary bus, so that transformers or feeders can be connected to one bus while extension work is being done on the other bus, disconnecting switches being used for this purpose. This construction has been found to be good enough in substations where it is necessary to have only one bus pressure. In cases where a high and a low bus are required, or where the substation load could be divided on two different systems, a double bus system with oil switch to each bus is necessary.

The K-6 oil switch consists of three single elements operated by one single solenoid, while the K-2 switch used on transformers and feeders is a single-pole switch with a solenoid for each element, so that any one phase can be operated independently of the others. Both types of switches are operated by direct current supplied by a storage battery charged by means of a mercury-arc rectifier set. A small knife switch is used for a control switch. The K-2 control switch is a special combination three-pole, single-throw knife switch so that all three phases of the feeders or transformers can be closed or opened at once or any single pole operated independently of the others.

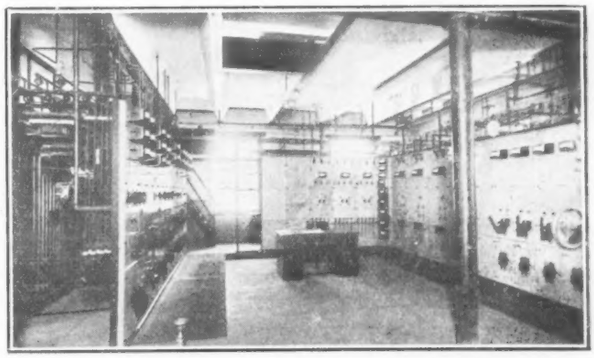


Fig. 13—Switchboard in LaGrange Substation.

From the K-2 oil switch the next step is through automatic regulators to a transfer switch. This transfer switch is a single-pole, double-blade, double-throw knife switch. One throw connects to the regulator, another throw to the transfer bus and the middle connects to the outgoing feeders. By means of this switch any one feeder can be fed from any other feeder in case it is necessary to clean the oil switch or work on any apparatus connected between the bus and transfer switch. In case of trouble with the regulator that particular phase can be thrown on to the transfer bus while the regulator is cut out of the service, the regulator being provided with transformer couplings so that this can be done in a very short time.

In cases where the transfer switch can be mounted near the line entrance it is also used as a line-disconnecting switch. The three-phase feeders leave the building through bituminous-fiber entrances. Lightning arresters, provided with disconnecting switches, are connected to each phase. The neutral is provided with a spark-gap, which is connected to the ground bus through a disconnecting switch.

ORGANIZATION, RECORDS, BUSINESS-GETTING, ETC.

The North Shore Electric Company reported for the fiscal year ended Sept. 30, 1910, capital stock outstanding of $4,964,000 and bonds amounting to $4,705,000. The gross earnings for the year were $1,386,062 and the net earnings $478,506, leaving $266,182 after paying bond interest. On Sept. 30, 1910, the connected business of the company, exclusive of railway business, was given as 453,238 16-cp equivalents. The growth of the business has been rapid. The officers of the company are as follows: President, Mr. Samuel Insull; vice-president, Mr. Frank J. Baker; secretary and treasurer, Mr. John H. Gulick; assistant secretary and treasurer, Mr. E. D. Alexander. The remaining heads of departments of the company are as follows: General superintendent, Mr. George H. Lukes; general contract agent, Mr. John G. Learned; purchasing agent, Mr. George R. Jones; mechanical engineer, Mr. J. L. Hecht. It should be added that Messrs. Sargent & Lundy, consulting engineers, designed the generating stations of the company.

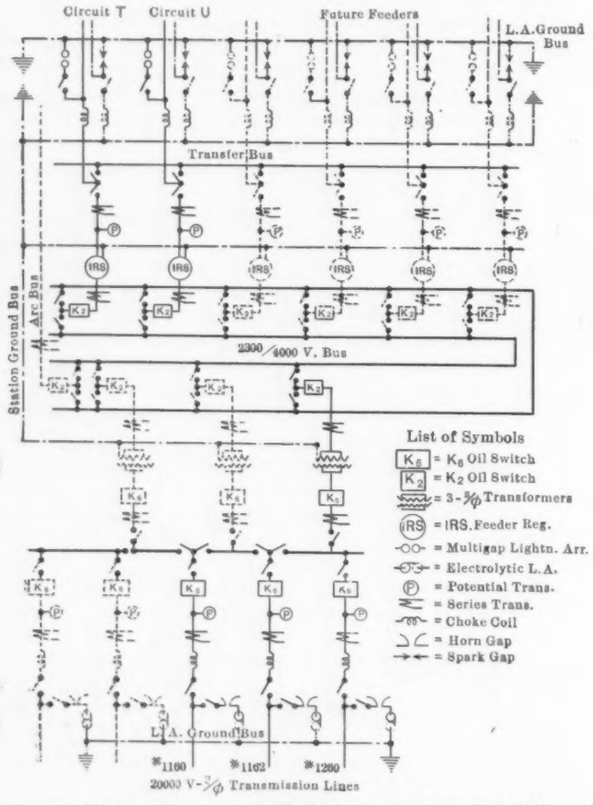


Fig. 14—Wiring Diagram of Typical Transformer Substation of the North Shore Electric Company.

Owing to the extensive and varied character of the territory served the matter of records assumes especial importance.

All territory inside of corporate limits, cities and villages is shown on maps drawn to a scale of 200 ft. to the inch. These maps are on sheets 16 in. x 19 in., each sheet showing a quarter section. Fig. 15 is a reproduction of one of these quarter-section maps, showing the location of poles and wires in a portion of Evanston. The sheets are mounted on cloth and bound in books. The poles occupied by the company are shown on these maps with appropriate symbols to indicate whether the pole is owned entirely by the company or jointly with others. The transformers, primaries, feeders, mains and secondaries are also indicated.

Circuit maps are also used, and they are intended to give a bird's-eye view of each circuit, being drawn to various scales, depending on the territory covered. They are, however, of uniform size, 16 in. x 19 in., and are also bound in book form. In these maps no attempt is made to indicate the poles, but the general route of the feeders and mains is shown together with the location of lightning arresters, junction fuses, etc.

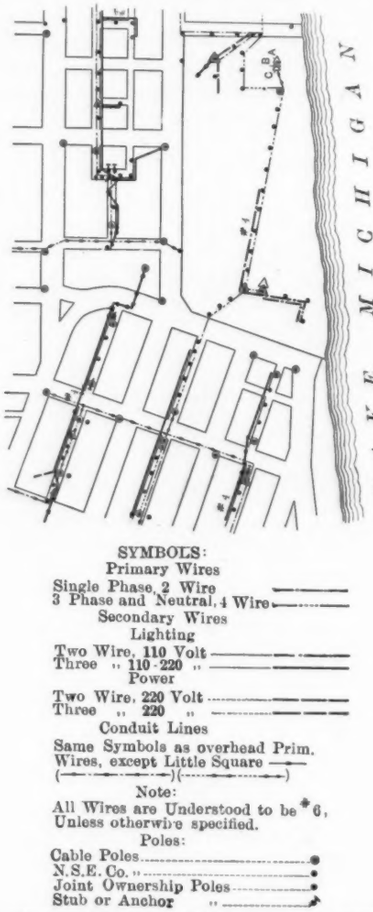


Fig. 15—Quarter-Section Map (Evanston, Ill.), Typical of Those Used in Records of North Shore Electric Company.

Street-lighting maps are also included in the records. These are similar to the circuit maps and show the routes of all street-lighting circuits, with the location of all street lamps.

Owing to the large territory served it has been found impracticable to maintain maps of the country region showing the location of each pole. However, maps on a scale of 4 in. to the mile have been made up to show the routes covered by the distribution lines in the country, and on these maps are indicated the number and sizes of poles between given points.

There are also transmission-line maps on various scales showing the routes of transmission lines. These maps may or may not indicate the location of each pole, depending on the importance of the line.

The rate charged by the North Shore Electric Company for electricity used for lighting is a maximum-demand rate of 14½ cents per kw-hour for the first thirty hours and 8 cents per kw-hour for the remainder of the bill. A discount of 1 cent per kw-hour is allowed for prompt payment. The power rate is a maximum-demand rate of 10 cents per kw-hour for the first thirty hours, 5 cents for the second thirty hours and 3 cents for the remainder of the bill, with a discount depending on the quantity used.

In securing new business methods must necessarily be adapted to the character and peculiarities of the territory served. The company's contract department consists of the general contract agent, an engineer, two power agents and twenty-three district solicitors. The general contract agent, the engineer and the two power agents make their headquarters at the general office in Chicago, while the solicitors make their headquarters at the district offices in the field. The district solicitors report through the district superintendents to the general contract agent. Each solicitor has a specific territory and he is held accountable for securing new business in his district. All of the employees of the company are very enthusiastic in relation to securing new business and co-operate freely with the employees of the contract department.

Liberal offers are made to secure new business. One of these relates to the wiring of old houses on the company's lines. The wiring of such houses and the furnishing of fixtures are done at cost and customers are given two years to pay the bill. The company also furnishes signs, tungsten clusters and ornamental street-lighting posts on a rental basis. Store windows are wired at a reduced price, and the company will furnish the original installation of carbon lamps for window lighting, furnishing renewals free of cost. Household appliances that may be attached to lamp sockets are placed among customers for a trial period of from seven to thirty days, depending upon the article placed. Some of these appliances are also sold under a twelve-month-payment plan.

Every effort is made to secure available power business by placing motors out on a rental basis and also selling them on time payments. The company advertises in about thirty-six newspapers in its territory and takes advertising space to an amount equal to the bill of the newspaper for electricity. The result of this practice has been very favorable. Direct-by-mail advertising campaigns are carried on continuously. Solicitors are paid a salary and commission on all business secured.

A recent addition to the company's activities is the establishment of storage-battery charging outfits for automobiles at all stations, all substations and some of the sub-offices. This is a great advantage to the increasing number of users of electric vehicles in the suburban area around Chicago. Rectifier sets are used to obtain the direct current for battery charging.

A METHOD FOR STUDYING THE INTERNAL INDUCTANCE OF LINEAR CONDUCTORS.

BY FRANK F. FOWLE.

THE internal inductance of linear conductors of certain types becomes of much relative importance when iron or steel forms the conductor material, wholly or partly. Iron conductors are employed to a large extent in telephony and telegraphy, and steel also. The latter is frequently used in long spans where copper or aluminum conductors form the remainder of the circuit, either for telephone, telegraph or energy transmission service. Compound conductors of copper and steel, or aluminum and steel, are also finding various uses. The properties of such conductors are becoming, on the whole, of increasing importance.

The inductance of any circuit composed of two or more open wires is susceptible of separation into the sum of two components, one of which is the inductance due to the magnetic field wholly outside of the conductors themselves and the other of which is the inductance due to the magnetic fields wholly within the conductors. The latter is termed the internal inductance or the internal component of inductance. The external component depends entirely upon the grouping of the conductors and their respective interaxial distances. The internal component depends upon the permeability of the conductor materials and, if copper-clad or aluminum-clad types are employed, upon the relative proportions, distribution and conductivity of these metals; if the conductors are placed close together there is still a further influence due to induced magnetization when iron or steel forms the material.

The internal inductance of a solid cylindrical homogeneous conductor is given by the well-known expression

$$L_1 = \tfrac{1}{2}\mu. \qquad (1)$$

While the expression is simple, the conditions within the conductor may be rather complex. This holds true especially in iron or steel conductors or in compound conductors of which those materials form a part. Considering first the simplest case, that of a homogeneous conductor, the flux distribution is in the form of concentric whirls about the conductor axis, in plane a perpendicular to the axis. The density is non-uniform and varies from zero at the axis to a maximum at the surface or circumference. The density is further affected by the permeability; if the latter is unity the density is everywhere equal to the magnetizing force and susceptible of exact calculation in a simple manner, but when the permeability corresponds in value to the properties of iron or steel the density is more difficult to determine. The magnetizing force is relatively small and the portion of the *B-H* curve which applies is quite below the ordinary range, so that special measurements would ordinarily be necessary. These are difficult to carry out because of residual magnetization, which exists to some extent even in the best grades of iron, and, of course, is more prominent in steel.

The value of inductance given in expression (1) is based on a constant value of permeability, which is not obtained, of course, in iron and steel. A value of μ which gives the actual or correct inductance in the latter case is necessarily an average or apparent value. No exact formula can be derived for L_1 under such circumstances without an analytical expression for the relation between B and H within the necessary limits. A direct physical determination of permeability from a sample of wire can be made by the usual methods, but it will not be possible to reproduce the peculiar flux distribution which ordinarily exists in the wire. An average value of the permeability determined from a *B-H* curve is not the proper value to use in expression (1) because annular elements of the wire section, of equal radial thickness, do not represent equal fractions of the whole internal inductance. In other words, the apparent or equivalent permeability of (1) is not easily found from a *B-H* curve; instead of being a simple mean it is a weighted mean, and the determination of the proper weights is not a simple operation.

The difficulties are increased, if anything, when compound wires are considered. The expression for the internal inductance of such a bimetallic conductor, taken from a serial article by the writer on "Electrical Properties of Compound Wires," which appeared in the *Electrical World* of Dec. 22 and Dec. 29, 1910, and Jan. 12, 1911, is given as follows:

$$L_{12} = \tfrac{1}{2}\mu_1 I_1^2 + 2\mu_2 I_1 I_2 + \tfrac{1}{2}\mu_2 I_2^2\left(1 - \frac{2r_1^2}{r_2^2 - r_1^2}\right) + 2\mu_2\left(I_1 - \frac{r_1^2 I_2}{r_2^2 - r_1^2}\right)^2 \log\frac{r_2}{r_1} \qquad (2)$$

where the subscripts $_1$ and $_2$ refer to the core and the concentric shell respectively, I denotes the proportion of the total current, r denotes the radius and μ the permeability. When the shell is composed of any non-magnetic material the value of μ_2 becomes unity and vanishes from all the terms of (2). The term which contains μ_1 corresponds to the core inductance and is identical with (1) except for a factor equal to the square of the proportion or percentage of core current with respect to the whole.

Since the inductance and the permeability of a homogeneous wire bear a numerical relation to each other, as shown by (1), it is obvious that one method of studying permeability is by

the measurement of inductance. This relates, of course, to the apparent permeability. The same applies to the case of a compound wire, such as copper-clad steel. Such a method, either independent of or coupled with physical determinations of permeability by one of the usual methods, should give satisfactory results if the internal inductance can be isolated from external inductance or if the latter can be made practically negligible.

The separation of internal and external inductance is not physically possible with ordinary loops of open wire, as circuits are usually constructed, nor would it be satisfactory to bring

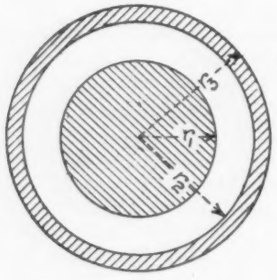


Fig. 1—Cross-Section of Linear Cylindrical Conductor with External Concentric Return.

the parallel sides of the loop close together because of complications in the resultant flux distribution. It is possible, however, to restrict the external field by utilizing a concentric return of non-magnetic metal after the plan of a concentric cable, as shown in Fig. 1. In this illustration r_1 represents the radius of the conductor, r_2 the inner radius and r_3 the outer radius of the concentric return. Such a method or arrangement has several obvious advantages. In the first place there could be no mutual inductance with any nearby circuits; in the second place, the external inductance can be made very small comparatively by making r_2 as nearly equal to r_1 as conditions will permit, and in the third place the flux distortion at the ends and the corresponding correction for end-effect can be made negligible without setting up an excessively long circuit for experimental purposes.

The internal inductance of the central conductor in Fig. 1

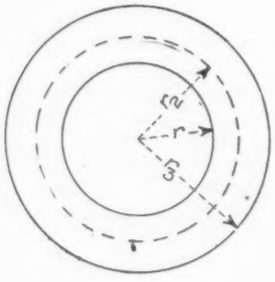


Fig. 2—Section of Concentric Return.

has already been given by expression (1). The external inductance is

$$L_2 = \int_{r_1}^{r_2} \frac{2\mu_2}{r} dr = 2\mu_2 \log \frac{r_2}{r_1} \qquad (3)$$

and the value of μ_2 will ordinarily be unity since it represents the permeability of the matter or substance between the two conductors. There remains only the internal inductance of the concentric return to complete the whole inductance. Referring to Fig. 2, which shows the concentric return, the total current strata inclosed within the radius r are given by

$$I_r = I_1\left(1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2}\right) \qquad (4)$$

or

$$\frac{I_r}{I_1} = 1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2} \qquad (5)$$

where I_1 is the whole current in the central conductor; the direction of the latter is taken as positive and the direction of current in the return as negative. Taking the whole current as unity, the field intensity at the end of a radius r is

$$B_r = \frac{2\mu_3}{r}\left(1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2}\right) \qquad (6)$$

The internal inductance is the product of expression (5) and (6) integrated between the limits of r_2 and r_3, or

$$L_3 = 2\mu_3 \int_{r_2}^{r_3} \left[1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2}\right]^2 \frac{dr}{r} \qquad (7)$$

$$= \frac{2\mu_3}{(r_3^2 - r_2^2)^2} \int_{r_2}^{r_3} (r_3^4 - 2r_3^2 r^2 + r^4)\, \frac{dr}{r}$$

$$= \frac{2\mu_3}{(r_3^2 - r_2^2)^2}\left[r_3^4 \log \frac{r_3}{r_2} - r_3^2(r_3^2 - r_2^2) + \frac{r_3^4 - r_2^4}{4}\right]$$

$$= \frac{2\mu_3 r_3^4}{(r_3^2 - r_2^2)^2} \log \frac{r_3}{r_2} - \frac{\mu_3}{2}\left(\frac{3r_3^2 - r_2^2}{r_3^2 - r_2^2}\right) \qquad (8)$$

The total inductance is the sum of three components, one for the core or inner conductor, one for the space between the conductors and one for the outer conductor, or

$$L_0 = L_1 + L_2 + L_3 \qquad (9)$$

$$= \tfrac{1}{2}\mu_1 + 2\mu_2 \log \frac{r_2}{r_1} +$$

$$\frac{2\mu_3 r_3^4}{(r_3^2 - r_2^2)^2} \log \frac{r_3}{r_2} - \frac{\mu_3}{2}\left(\frac{3r_3^2 - r_2^2}{r_3^2 - r_2^2}\right) \qquad (10)$$

This formula gives the inductance in c.g.s. units, using Napierian logarithms. The latter are obtained from common logarithms by means of a multiplying factor of 2.3026. The factor for converting (10) from c.g.s. units to mil-henries per 100 ft. is 0.003048.

For experimental purposes it would be possible to set up perhaps 100 ft. of iron, steel or copper-clad steel conductor as the core in an arrangement like Fig. 1; this could best be in one continuous straight line. After serving the conductor with a single wrapipng of paper for insulation, a split concentric return of sheet metal (perhaps copper) could be applied and held in place by turns of twine or insulated wire. The outer or return conductor could be made in suitable sections with butt joints and a bonding of solder. At one extreme end the conductors would be joined and the opposite ends connected to the measuring apparatus through short twisted leads. The whole arrangement amounts to an experimental concentric cable with minimum insulation thickness between conductors.

Assuming that the core conductor was No. 8 B. W. G. iron with a diameter of 0.165 in., wrapped with paper having a thickness of 0.004 in. and a concentric return of No. 24 B. & S. gage (0.0201 in. thick), the several elements of the whole inductance in c.g.s. units would be as follows, assuming $\mu_1 = 1000.0$, $\mu_2 = 1.000$ and $\mu_3 = 1.000$.

$$L_1 = 50.000$$
$$L_2 = 0.095$$
$$L_3 = 0.152$$
$$\overline{\qquad\qquad}$$
$$L_0 = 50.247$$

If a precision of only 0.5 per cent in the final result was necessary, the values of L_1 and L_2 could be almost neglected, or, in other words, no correction need be applied to the measured result of value of L_0 in arriving at the inductance or the apparent permeability of the iron core. The corrections ought

to be calculated for each case, however, to settle the question of their negligibility.

It would be possible to incase the iron conductor in a metal tube if preferable for any reason, instead of the arrangement just described. The tube could be cut into suitable sections with the joints bonded; of course, the tube diameter should be made small so as to leave but little space between the two conductors. Collars of fiber or dry wood could be used to keep the core central with respect to the tube.

This proposed method is also suitable when the core conductor is stranded, either of iron, steel or copper-clad steel. The theoretical investigation of internal inductance for a conductor of this type is necessarily complicated owing to the altered character of the magnetic circuit and the accompanying distribution of flux. The flux densities would lie between very wide limits and the corresponding variations in permeability would render the theoretical treatment very difficult, except possibly by some approximate method.

The theoretical deductions given above are based entirely on the assumption that the current densities are uniform over each conductor cross-section, or, in other words, it is assumed that the current penetrates the conductor fully. This is true for continuous or low-frequency alternating currents, but is modified by the skin effect at high frequencies. Under the last conditions it would be necessary to introduce still another correction for the shunt capacity effect due to the condenser action between the core and its concentric return. The method is designed, however, to investigate the properties with continuous or low-frequency alternating currents as determined by the usual conditions of energy transmission.

USE OF FLYWHEEL SET TO EQUALIZE ORE-DOCK LOADS ON CENTRAL-STATION SYSTEM.

A FLYWHEEL equalizing set, comprising a 300-kw direct-current machine connected to a 25-ton flywheel and acting alternately as a motor and as a generator, storing up energy from the line or returning it on demand to the local hoisting load (the momentary peaks of which may reach 3500 amp at 250 volts), is installed at the new Toledo ore docks of the Cincinnati, Hamilton & Dayton Railroad, the energy to operate which is purchased from the 4000-volt alternating-current transmission system of the local central-station company. This equalizing set, employing the flywheel-inertia principle invented by Mr. H. Ward Leonard, is the first of its kind operating in conjunction with a rotary converter supplied from an alternating-current source. Not only does the flywheel set prevent the heavy surges of demand from reaching the central-station company's line in their bare, aggravated form, but it will also enable the dock installation to earn a lower rate for its energy supply, resulting from the decreased peak demands. The new ore-dock installation was completed on schedule time, Jan. 1, and was to have been tested immediately, but ice in the Maumee River at Toledo has made it dangerous to tie an ore vessel to the dock for practical unloading, so that the first actual use of the new installation may be delayed until spring.

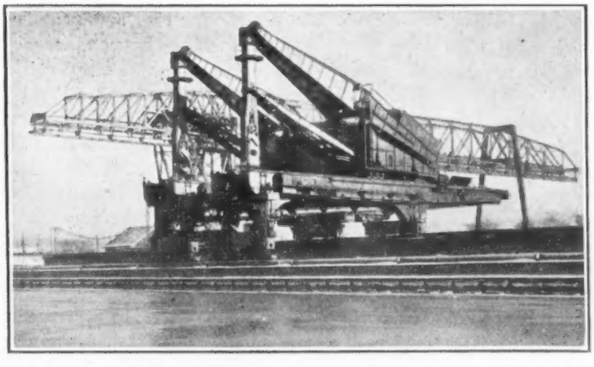


Fig. 1—Vessel Unloaders and Movable Bridge Structure of New C., H. & D. Ore Docks, Toledo.

This new Cincinnati, Hamilton & Dayton dock has a storage space 700 ft. long by 420 ft. wide, with a capacity for 1,000,000 tons of iron ore. Along the water's edge run two vertical rotating-leg vessel unloaders, each carrying a 15-ton bucket. These discharge into cars or into an intermediate pile from which the bridge bucket takes. The bridge spanning the main storage area, and on which the trolley carriage with its 10-ton bucket runs, is a 420-ft. steel structure moving the 700-ft. length of the dock on two elevated rails 280 ft. apart. An unusual feature of this bridge has been the extension of the 125-ft. waterside cantilever, which overhangs two railroad tracks and enables the bridge bucket to load cars directly from the main storage pile. The trolley carriage has a velocity of 800 ft. per minute along the bridge, while the latter has its own lateral motion of 150 ft. to 200 ft. per minute on its rails. Each of the two unloaders is designed to unship 400 tons of ore per hour, with two men in the hold "cleaning" up the ore and shoveling it to the buckets as the bottom is reached. The ore dock itself represents an interesting piece of filled construction in the shoals of the Maumee River at this point. Nearly 800 wooden piles were first driven, and around these sand excavated from the future channel way and turning basin by a suction dredge was deposited until the surface was raised above normal river level. The foundations and anchorings for the dock structures are said to be the heaviest in the Great Lakes region.

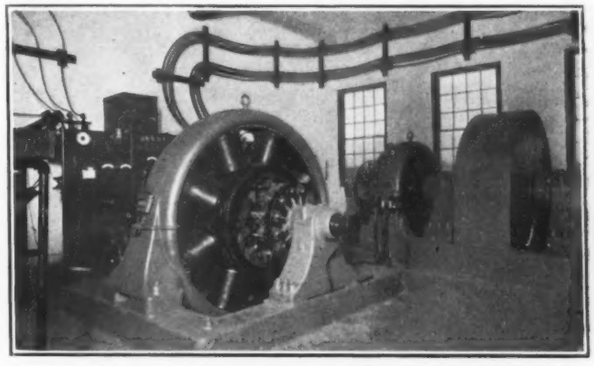


Fig. 2—Rotary Converter and Flywheel Equalizing Set.

Energy to operate the hoists and traveling motions of the dock structures is received in the form of 4000-volt, 25-cycle, three-phase alternating current from the power house of the Toledo Railways & Light Company, nearly three miles distant. In the substation on the dock property this 4000-volt energy is reduced to 170 volts by three 185-kw transformers, from which it passes to the alternating-current side of the rotary and is converted into 250-volt direct current for supplying the crane-trolley rails, both polarities being of the protected type and insulated from ground.

Across these 250-volt buses is floated the flywheel-generator set. This comprises an essentially standard-type compound-wound direct-current machine, the armature of which is rigidly connected to a 25-ton flywheel and runs at 600 r.p.m. Although normally taking energy from the line and running as a motor, in case of excessive peaks of demand by the bridge or unloader apparatus this unit is converted into a generator, supplying energy to assist the rotary converter and line in meeting the heavy load. When the current taken by the load exceeds 1500 amp a reverse-current relay closes contacts to a magnet switch which short-circuits the series winding of the flywheel machine, enabling it to pick up as a shunt-wound generator, sharing the peak demand with the rotary converter. Since the flywheel must meanwhile develop this energy at the expense of its velocity of rotation, as the speed falls, magnet switches close in succession cutting out field resistance of the generator, holding up the latter's voltage. At its maximum drop in velocity the speed of the flywheel set does not fall below 80 per cent of

its normal rate, 600 r.p.m. The flywheel outfit is designed to carry an 850-kw demand for fifteen seconds before reaching the limit of its velocity drop. The combined rating of the machines is sufficient to meet any load that may be imposed by the concurrence of the heaviest demands of both unloaders and the bridge. In case the alternating-current supply should be interrupted sufficient energy would be residual in the flywheel rotating at 600 r.p.m. to lift both 15-ton unloader buckets out of the vessel's hatches, releasing her from the dock in

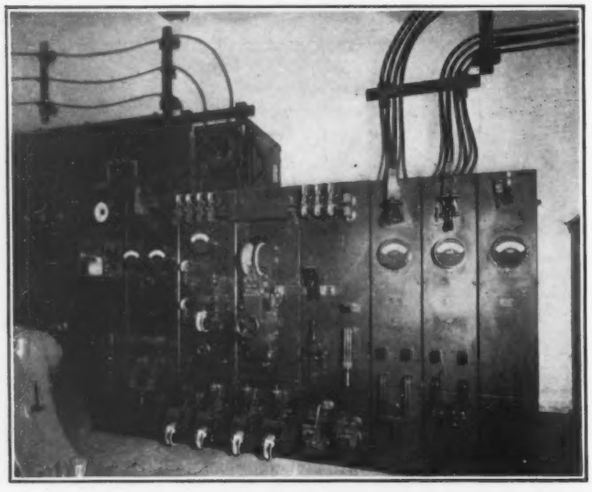


Fig. 3—Switchboard and Automatic Control Apparatus of Flywheel Equalizing Set.

case service could not be at once restored. Some idea of the small amount of power absorbed by the 25-ton flywheel when running will be afforded by the statement that with brushes in place but field off this set will continue to turn for three hours before coming to rest from an initial speed of 600 r.p.m. The rotary converter has a rated output of 2200 amp at 250 volts, while that of the flywheel generator is 1200 amp, making it possible to absorb peaks up to 3400 amp or more without disturbance to the alternating-current lines outside of the sub-

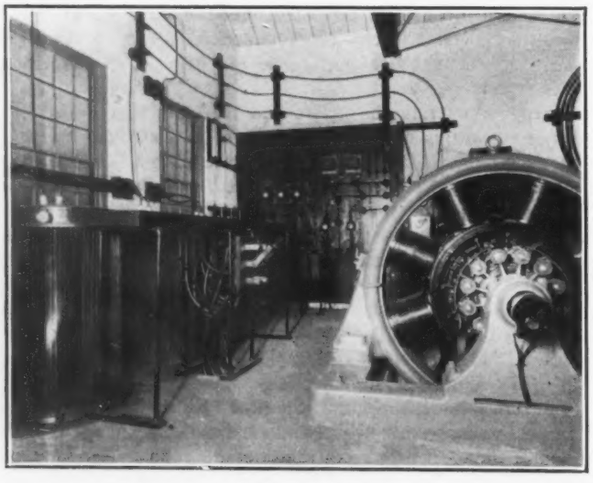


Fig. 4—High-Tension Entries, Transformers and Rotary Converter in Dock Substation.

station. A curve-drawing wattmeter is installed on the switchboard for recording current demands. The starting contactors for the flywheel set are also mounted on the switchboard, together with the main direct-current circuit-breaker, which is fitted with an overload relay having a coil of one turn, the magnetic circuit of which simply incloses the main bus. Similar elementary windings are also employed to operate many of the other relays on the board, the single winding being sufficient in view of the large current conveyed by the huge buses.

Experience with the new flywheel set when using the conveyor machinery to hoist small quantities of ore from the storage piles indicates that both peak demand and energy consumption are saved for the customer. A flywheel set operating on 550-volt direct current from the trolley-feeder lines of the electric company has already been in use at another Toledo dock for a year and is very effective in smoothing out demand peaks, although, of course, this is less important in the case of a trolley system than on a commercial power line and lighting system.

The unloading and bridge-transferring equipment of the new Cincinnati, Hamilton & Dayton dock was built and erected by the Wellman-Seaver-Morgan Company. The flywheel-equalizing set and rotary-converter apparatus were furnished by the Allis-Chalmers Company, and the automatic control switchboard was designed and built by the Cutler-Hammer Manufacturing Company.

SPECIFICATIONS AND TESTS FOR INSULATING TAPE.

By William P. Munger.

So far as the writer is aware, there have not appeared adequate specifications and tests for that most important material—friction tape. Some writers and most users advocate the inspection of tape for closeness of weave, thickness, ratio of friction compound to braid, and other unimportant qualities. The six qualities to which all the other qualities are contributory and for which standards and tests should be set are:

1. Insulation, the property for which tape is used.
2. Character of compound, a quality often neglected.
3. Adhesiveness, which mainly determines the life of the joint.
4. Mechanical strength, important mainly from the workmen's viewpoint.
5. Feet per pound.
6. Durability.

The last two items determine the real cost.

A good specification and test for insulation is that given at the September, 1910, meeting of the Pennsylvania Electric Association by Mr. Thomas Sproule, chairman of the committee on overhead-line construction. (See *Electrical World*, Sept. 22, 1910.) This specification should be amended by stating that the standard taped joint shall be made with ¾-in. tape.

The test for injurious substances in the compound is best made by boiling a portion of the sample for two hours in distilled water and testing separate portions of the aqueous extract with litmus paper for reaction; with silver nitrate and nitric acid for chlorine; with barium chloride and hydrochloric acid for sulphur compounds, and by the cyanide method for iron. If black specks are found in the aqueous extract which it is impossible to dissolve in dilute or strong hot acid, the compound probably contains free carbon and the tape should not be used if other is obtainable. It is obvious that the compound should not contain drying or semi-drying oils, and, although it is not practicable to insist on their entire absence, other conditions being the same, that tape should be favored which contains the least amount of these undesirable oils. The percentage of compound to braid in the finished tape is not always easily determined, and is really unimportant except that there should be enough to impregnate the braid sufficiently and give the maximum adhesiveness.

In order to find the numerical values of other qualities several standard brands of tape were recently tested in the laboratory of the Stromberg-Carlson Telephone Manufacturing Company.

The adhesiveness was obtained by the following method: Take two pieces of the sample, lap the adhesive side of the end of one onto the back of the other, and press the lap between hard-rubber sheets held in the jaws of a bench vise, so as to give a pressure in making the joint which can be exactly

reproduced in the next test. Then clamp each free end of the strip thus made in a set of jaws so arranged that they can be moved apart and a constantly increasing tension applied to the strip. The length taken between the jaw-sets should be about 80 cm. It is obvious that in operating this device enough tension will finally be applied to either break the tape outside the joint or cause the joint to fail. By repeated trials a length of lap will be found when the tape will break and the joint fail at the same instant. No account is taken in this test of the mechanical breaking strength because that is a separate specification. The results on the several samples are shown in columns 1 and 2 of Table I.

TABLE I.—RESULTS OF TESTS OF INSULATING TAPES.

Sample No.	Length of Splice.		Breaking Strength.		Feet per Pound. (5)	Meters per Kilogram (6)	Effect of Drying.	
	Inches (1)	Centimeters (2)	Pounds (3)	Kilograms. (4)			Wgt. Loss per Cent.	Appearance. (8)
1	4.25	10.7	38.0	17.23	93.0	62.36	1.94	Fairly adhesive.
2	1.50	3.8	34.1	15.46	153.0	102.59	1.84	Not very adhesive.
3	6.00	15.2	38.9	17.63	108.6	72.86	3.14	Unaltered.
4	1.75	4.4	35.9	16.28	144.0	96.56	1.96	Fairly adhesive.
5	2.50	6.3	36.7	16.64	165.0	110.64	0.51	Fairly adhesive.
6	3.00	7.6	....	.....	120.0	80.46	1.62	Dead.
7	5.00	12.7	40.6	18.41	117.0	78.45	3.30	Nearly dead.
8	3.50	8.9	35.9	16.28	193.8	129.41	2.30	Dead.
9	4.50	11.4	42.7	19.32	150.3	100.78	2.40	Dead.
10	7.50	19.0	23.3	12.56	165.9	111.24	2.20	Dead.
11	12.00	30.4	36.4	16.51	156.2	104.74	0.20	Dead.

The tape should be of sufficient strength to permit being tightly wound or applied without tearing or other injury. Samples of tape 0.75 in. wide were broken in a Schopper machine to determine what breaking strength should be the minimum requirement. During the tests, reported in columns 3 and 4, the jaws of the machine were protected from the adhesive material of the tape by strips of thin paper stuck on to the part clamped.

The number of feet per pound was obtained by weighing a strip of ¾-in. tape 3 ft. long and dividing this weight by three. For converting from grams into pounds avoirdupois use is made of the factor 453.6, the approximate number of grams in a pound. These figures are given in columns 5 and 6 of the table of results.

An adequate test for durability is hard to find, but in the absence of a better method the samples were suspended in dry air at 220 deg. Fahr. for four hours and the results obtained were as given in columns 7 and 8 of Table I.

Tabulating the samples in order of merit Table II is obtained.

TABLE II.—ORDER OF MERIT OF SAMPLE TAPES TESTED.

Length of Splice.	B. S.	Feet per Pound	Wt. Loss.	Appearance.
2	9	8	11	3
4	7	10	5	5
5	3	5	6	4
6	1	11	2	1
8	5	2	1	2
1	11	9	4	7
9	4	4	10	6
7	8	6	8	8
3	2	7	9	9
10	6	3	3	10
11	10	1	7	11

The samples listed above the dash are above the minimum requirements as set in the specifications which follow. It will be seen that samples 2 and 5 in each case were above the minimum requirement, while sample 4 was below only in feet per pound.

The rank of the tape which passed the character-of-compound and insulation tests and is above the minimum requirements should be determined, first, by the stability of the adhesiveness as taken by the heat test given above; second, by length of splice; third, by feet per pound, and, fourth, by breaking strength.

The following complete specifications are given, not as final, but as a contribution to the progress of testing and standardizing materials:

SUGGESTED SPECIFICATIONS.

General.—The article desired under these specifications consists of a thin, flat woven braid or tape of uniform width, thickness and strength throughout, impregnated with an adhesive and insulating compound, adhering firmly to the braid, and containing no sulphur, chlorine, iron or other compounds which will act injuriously on metals or the braid.

Compound.—The right is reserved to reject, without further test, any and all tape which shows the presence of injurious impurities in the aqueous extract obtained by boiling a sample in distilled water for two hours.

Insulation.—When submerged in water, and after having been submerged in water continuously for forty-eight hours, a standard taped joint shall have an insulation resistance of not less than 1000 megohms. The joint to be tested shall be a standard Western Union joint in No. 14 B. & S. gage, outside distributing wire. The distance between the ends of the insulation or length of the bare wire exposed in the completed joint shall not exceed 1.5 in. (38 mm). The joint shall be wound with two wrappings of tape, 0.75 in. wide (19 mm), put on in reverse layers with 0.5 in. (12 mm) overlap, the length of the taped joint to be 2.5 in. (64 mm). In testing the tape the joint and 2 ft. (161 cm) of the wire shall be immersed in the water.

Adhesiveness.—When the friction side of an end is pressed firmly onto the reverse side of another end and the free ends subjected to uniformly and slowly increasing tension, the length of the lap, when the joint fails, and at the same time the tape tears outside of the joint, shall not be more than 102 mm, or about 4 in.

Strength.—The breaking strength of a length of tape (0.75 in. wide) broken in any accurate tensile-strength machine (the distance between the jaws of which when the tape is in position to be tested is 105 mm, or approximately 4.125 in.) shall not be less than 33 lb., or approximately 15 kilos. The average of four lengths thus broken shall be considered the breaking strength of the sample.

Weight.—The total length of 0.75-in. (19 mm) tape as delivered shall not be less than 150 ft. per pound (100.6 m. per kilogram), other widths in proportion.

Durability.—The compound on the tape shall be insoluble in water at ordinary temperatures and when exposed to a moist atmosphere of approximately 90 per cent humidity at 80 deg. Fahr. for forty-eight hours shall absorb not more than 2 per cent by weight of moisture.

When exposed suspended in single strips (not rolled) to still dry air at 220 deg. Fahr. for four hours the tape shall not lose more than 2 per cent by weight, nor shall it be hard and stiff or have lost its adhesiveness to such a degree that a good joint cannot be made with the sample after cooling to ordinary temperatures.

If kept in the original package the tape shall be guaranteed to show no marked deterioration in adhesiveness, strength or insulation at the end of one year.

Delivery.—Unless otherwise expressly specified the tape shall be delivered in rolls ¾ in. wide (19 mm), weighing ½ lb. avoirdupois (0.227 kilo), each roll packed in a separate carton or box.

ELECTROPLATED PORCELAIN.

One of the popular lines for which American jewelers have been finding a rapidly growing market during the past few years is that of glassware decorated with a network of thin silver in a variety of ornamental designs. This silver coating is applied by an electro-deposition process which has greatly cheapened the cost of such glassware over that of the original

hammered silver plate. The same process could undoubtedly be used for coating the whole exterior of a tumbler, vase or other article with a shell of metal, but for most pieces of glassware this would detract from the appearance. However, if such a continuous coating were applied to porcelain the resulting product would combine the heat-insulating and easy-cleaning qualities of the porcelain with the rich appearance of the solid metal. The combination should also be superior in wearing qualities to both the fragile porcelain and the easily dented metal, and this at a decided saving in cost over that of solid silver or even plated silverware.

Such a line has lately been offered on the European market by the Electro-Porzellan-Werke, of Berlin, under the attractive name of "Electro-Porcelain." This ware as at present offered consists chiefly of platters, bowls, tureens, tea-kettles, coffee-pots, tea sets and egg dishes. Where covers are required, these are plated in the same way, but are left loose, as usual with chinaware, instead of being hinged. The metal coating is generally of silver, though the same designs are also offered with nickel casings at a reduction of about 10 per cent in the price. Some articles are also made of porcelain with the usual white inner surface and the outside glazed a rich brown, but having only the handles, knobs and edges of the covers and openings nickel-plated. The process of manufacture is understood to be based on a patent issued to Mr. Alexander Gerbing for producing a conducting coating on a non-conductor. Mr. Gerbing does this by dissolving the silicate of some alkali, suspending finely powdered graphite in the solution and applying this to the surface of the porcelain.

How much cheaper this rich-looking product can be than the solid metal is apparent from the German list prices as shown by the following: Platter, 14 in., with silver bottom and rim, $3.80; teapot with silvered exterior, 1-liter size, $3.35; milk pitcher. quart size, brown glazed, with silver plating only on handle and around mouth, $1.50.

Every housewife knows how much easier it is to clean the interior of a porcelain vessel than one of silver, hence such a metal-coated line should find a ready market and its introduction may add another to the already long list of electrical manufactures.

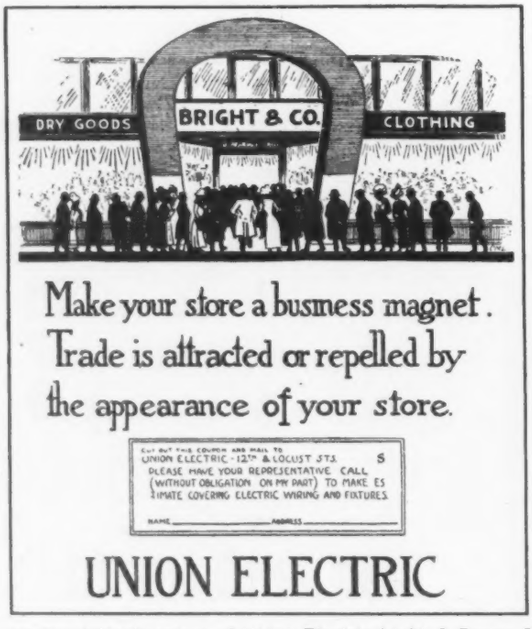
Central Station

Management, Policies and Commercial Methods

CENTRAL-STATION ADVERTISING IN ST. LOUIS.

The accompanying facsimile of a recent advertisement in a St. Louis daily by the Union Electric Light & Power Company, a liberal buyer of newspaper advertising space, will show the broad, simple lines on which this advertising is conducted, with one striking idea made prominent. As originally printed this announcement occupied a space 6.5 in. wide and 7.625 in. high.

Simultaneously the company does much street-car adver-



Newspaper Advertisement of Union Electric Light & Power Company, St. Louis.

tising with panel cards to which are attached blocks of detachable mailing cards containing on one side arguments for electric lighting and on the other the address of the company and blanks for the name and address of the "prospect." The street-car passenger who is interested tears off a post card, inscribes his name and address on it, attaches a 1-cent stamp and drops it in a mail box. The company does the rest.

TUNGSTEN STREET-LIGHTING DEVELOPMENT AT ALBERT LEA, MINN.

The small amount of money appropriated for street-lighting purposes in American cities, and especially in the smaller towns throughout the Central States, has been a matter of frequent comment in these columns. As far as the downtown districts in the larger towns are concerned this condition has been improved in recent years by the introduction of special lighting of various kinds, either on ornamental posts or by arches and festoons of lamps. In the "Northwest," which is the term frequently applied to the territory tributary to St. Paul and Minneapolis, the development, especially in street lighting of downtown districts, has been particularly notable because it has been taken up by small towns of 5000 to 10,000 inhabitants, where it might be expected that such expensive installations would not be thought feasible. This movement is a striking testimonial to the progressiveness of the people of these Northwestern towns.

In the *Electrical World* of Dec. 9, 1909, page 1421, was described the first installation of ornamental tungsten-lamp posts

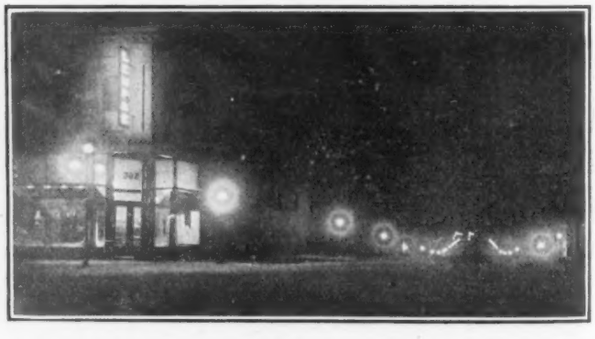


Fig. 1—Single-Lamp Tungsten Posts on Residence Street, Albert Lea, Minn.

made at Albert Lea, Minn. This was one of the pioneer towns in the Northwest to take up such lighting and the installation was remarkable at that time because of the size of the community, it having a population of only about 6000.

Recently another installation of posts has been made in Albert Lea that is even more remarkable and significant than the first, because it marks the introduction of street lighting

with tungsten lamps on ornamental posts at frequent intervals on a long stretch of residence street. This new installation, which is on Main Street, consists of seventy-seven posts, each having one 60-watt tungsten lamp, tip upward, inclosed in a 14-in. opalescent globe. The posts are set about 85 ft. apart, or eight to a block. The installation, like that on Broadway before described in these columns, was made and paid for by the Albert Lea Light & Power Company, of which Mr. Ludwig Kemper is treasurer and manager. The municipality

Fig. 2—Three-Lamp Tungsten Posts on Business Street, Albert Lea, Minn.

contracted with the company for the lighting and maintenance of these posts for a period of ten years.

The single-lamp posts on Main Street are shown in Fig. 1. The contract price per year for these is $24.50 on an all-night, every-night schedule. Mr. Kemper states that the cost of installation, including all underground work, was $43 per post. The post itself, complete with globe and lamp, costs $32 delivered at Albert Lea. The heavy ornamental cast-iron post was made by Mott & Company, of New York. Charging 15 per cent for interest and depreciation and $3 per post per year for maintenance, the electric light company figures that it nets 6 cents per kw-hour. The lamps are operated on 110-volt multiple circuits. The wiring is placed underground in ¾-in. plain iron-pipe conduits buried about 2 ft. under the surface in the parkway inside the curb line.

The original installation on Broadway, which is the main business street, consists of fifty-two three-lamp posts. The appearance of this street at night is shown in Fig. 2. The company receives $45.10 per post for this three-lamp lighting. Each post carries two 60-watt and one 40-watt multiple tungsten lamp. One 60-watt lamp burns all night every night, and the other two lamps until midnight. This lighting is also done under a ten-year contract.

CENTRAL-STATION LECTURES ON ILLUMINATION.

An interesting and successful experiment in central-station publicity work was recently conducted by the Stearns Lighting & Power Company, of Ludington, Mich. Assisted by representatives of the Fostoria Incandescent Lamp Company and of the Holophane Company two public lectures on illumination were given at the Opera House at that city on Thursday evening, Jan. 26, to a large audience. Although the affair had been widely advertised, some misgivings as to its success were felt Thursday afternoon, both because the weather was inclement and because there were two other attractions scheduled for 8 o'clock, the hour set for the illumination lectures. The fact that the lectures drew a full house—over 900 persons out of a total population of about 10,000 being present—was therefore doubly gratifying to those in charge.

The first speaker of the evening was Mr. Ralph Beman, of the National Electric Lamp Association, who gave a thirty-minute address on residence and store lighting, with particular reference to the efficiency and wide applicability of metal-filament lamps. Mr. Beman's talk was illustrated by about thirty lantern slides showing good and bad examples of store and residence illumination.

A very simple demonstration, made for the purpose of showing the enormous range of sizes in which metal-filament lamps may be had, astonished not a few in the audience. The demonstration consisted in switching off all the lamps in the theater and then turning on, first, a 1-cp pocket flashlamp, and, second, a 400-watt (350-cp) incandescent, which lighted up the whole room.

The second speaker was Mr. Harry F. Swindell, of the Holophane Company, whose address on the use of reflectors as affecting illumination occupied an hour. Various types of reflectors, including those especially designed for residence lighting, were demonstrated and explained by Mr. Swindell.

Musical numbers preceded and followed each of the lectures and added much to the pleasure of the audience. Numbered coupons were given in exchange for the admission tickets at the door, and upon the conclusion of the program at 10 o'clock an art-glass electric table lamp was presented to the holder of the "lucky" coupon.

The purpose of the lighting company in giving an entertainment of this unwonted variety was twofold: First, to show its consumers the importance of proper selection of illuminating equipment and intelligent laying-out of installations if satisfactory service is to be secured; second, to present the advantages of electric lighting before prospective customers. The meeting was advertised in the daily papers for a week, display cards were placed in the store windows and admission tickets and invitations were sent out by mail.

Results in the shape of inquiries at the lighting company's office began to be manifest as early as 9 o'clock on the morning after the lecture. One of these early inquirers who sought advice on how to make the show-window lighting of his store more effective decided to replace the one 187-watt graphitized-filament lamp and obsolete reflector which then adorned his window with five 60-watt metal-filament lamps and corresponding reflectors of modern design. Within a week over a score of direct inquiries resulting from the meeting had been received. The success which this means of central-station publicity met at Ludington could be repeated in the great majority of central-station towns.

No effort is spared by the Stearns Lighting & Power Company to give its customers good service. Such an occurrence as an interruption of the lighting service is practically unknown, and the voltage regulation, owing to the use of generator and feeder regulators, is very close. One of the reasons for the public meeting above described was that it was felt that the company's efforts to give continuous, well-regulated service would be of little avail so long as obsolete illuminating devices remained in general use on the consumers' premises.

The power plant is operated with exceptional economy, presenting an interesting example of the utilization of by-products. As a sawmill and a salt plant are controlled by the same interests that operate the lighting and power company, sawdust from the sawmill is used for fuel under the boilers of the power house, while the exhaust steam from the engines, at 10-lb. pressure, is used in the evaporation of salt. The daily peak load on the three generators is normally about 1100 kw. Mr. F. W. Hawley is manager of the central station.

Energy for residential use is sold on a sliding-scale meter rate which varies from 10.8 cents to 5 cents per kw-hour according to the number of kw-hours used per month. The price of illuminating gas in Ludington is $1.30 per 1000 cu. ft.

ANNUAL REPORT OF A CENTRAL-STATION SALES DEPARTMENT.

By H. W. Hillman.

In the organizations of the vast electrical manufacturing corporations which transact a business of more than $1,000,000 every six days, there are sales offices all over the world, and the sales department is considered to be one of the most important departments of the corporation. In connection with central stations the situation has been a little different. Compara-

tively speaking, it has been but a short time that much importance has been attached to the sales department. How easy it is to remember the time when there were no exhibition rooms for the display of electrical devices, when very little advertising was done by the local companies and a well-educated electrical solicitor was unknown!

Now the situation has changed. The small stations, as well as the large, pride themselves upon the character of their salesrooms; advertising is quite as common among electric light plants as among the merchants of the community, and electrical solicitors are as numerous as any other class of salesmen in the country.

TABLE I.—"SERVICE IN," IMMEDIATE PROSPECTS.

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	25	20	10	60,000	$57.10	$1,147.50
2	5	5	3	5,000	40.00	140.00
3	5	5	4	3,000	30.00	81.00
4	30	25	20	15,000	500.00	300.00
5	150	100	75	200,000	168.00	3,000.00
6	15	10	6	3,000		81.00
7	1	1	¾	1,800	30.00	44.00
8	3	3	2	2,700	50.00	54.00
9	100	75	35	105,000	150.00	1,575.00
10	1	1	1	900	20.00	27.00
11	15	15	10	10,000	30.00	300.00
	350	260	166¾	406,400	$1,075.10	$6,749.50

Aggressiveness in the sales department is commendable. Activity and bustle exhibited in the sales office of the electrical corporation are good for the public to notice; but, after all, the question is, What do all the activity and the aggressiveness amount to if the general manager is continually bothered with contracts which have been signed covering business "off the lines"? What do they amount to if the general manager finds that the business is not well assorted; that it is too much of one kind; that it is pointing too much toward low-price transactions?

It is appropriate to stop and think for a moment of what are the real duties of the sales department just at this season. The writer names but one, and it is timely: Frospective business report for 1911. By all means get it out before the general manager requests it. He has enough things to do.

TABLE II.—IMMEDIATE MOTOR PROSPECTS, "ON THE LINE."

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	15	12	7½	3,000	$97.10	$80.00
2	5	5	4	5,000	95.00	125.00
3	125	100	100	150,000	358.10	1,900.00
4	20	20	15	25,000	132.10	620.00
5	15	20	10	50,000	277.10	1,150.00
6	35	30	15	30,000	91.10	600.00
7	2	2	2	750	42.00	22.00
8	2	2	1	750	50.00	22.00
	219	191	154½	264,500	$1,142.50	$4,519.00

Surely it will be appreciated if you will bring your report to his desk, thoughtfully arranged, intelligently classified, and also recapitulated for his general observation, but filled with valuable, interesting details if he should desire them.

But how to make out such a report! There's the rub! It has not been called for before. What is the object of such a report? Will the general manager have any practical use for it, or is it like some other reports with which all are more or less familiar, which have required nights and days to compile, with enormous amount of detail, only to be filed and sidetracked for data of more practical character?

The writer will first give some idea of how to make out the report; then describe how valuable it is to the head of the sales department; then its value to the engineering department and to the general manager, and finally how such a report becomes a necessity for the proper guidance of the executive committee and the board of directors whenever large appropriations for extensions and new generating apparatus are brought up for approval. Table I shows the way to begin such a report. It is wise to begin in this manner because the business indicated is the most desirable which can be found. The service is already in; it costs little to secure the contracts; it is the most immediate of all business in prospect. Table II shows the way to include the second page of details. This is the class of business next most desirable. It is "on the lines"; only secondary service is necessary to run it, and it is considered immediate. Tables III and IV show business for industrial purposes that should be watched carefully. Table V shows extensions on motor circuits. Sometimes members of the sales department are discouraged over this class of business because the general manager has given strict orders not to go after it. But it is important business nevertheless. The active, enthusiastic agent continually watching such business will some day be rewarded by finding that the policy has changed. The company wants the business. A disgruntled solicitor who has the habit of finding fault about occasional arbitrary decisions of the general manager regarding extensions will wake up some morning and find that an isolated plant has been installed and the business lost to the company.

TABLE III.—"SERVICE IN," SLOW MOTOR PROSPECTS.

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	250	200	125	375,000	$233.00	$3,600.00
2	150	60	40	50,000	525.50	1,000.00
3	300	220	200	600,000	150.00	6,000.00
4	150	110	100	540,000	4,000.00	5,652.00
5	450	400	300	480,000	100.00	6,000.00
6	1,000	1,000	1,000	336,000	375.00	5,040.00
7	200	175	150	100,000		1,000.00
8	50	40	25	60,000	50.00	900.00
	2,550	2,205	1,940	2,541,000	$5,433.50	$29,192.00

TABLE IV.—SLOW MOTOR PROSPECTS, "ON THE LINE."

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	15	15	10	25,000	$84.00	$575.00
2	150	70	50	60,000	143.00	1,200.00
3	20	18	10	18,000	124.60	459.00
4	15	14	12	25,000	55.10	531.25
5	15	15	15	25,000	57.10	531.25
6	100	50	30	75,000	88.10	1,311.00
7	35	30	20	40,000	61.10	700.00
8*	56	50	36	305,530	550.00	4,500.00
9	40	40	30	259,000	270.00	3,237.00
10	15	15	7	5,000	87.10	105.00
11	30	25	15	17,500	121.10	350.00
12	50	40	35	50,000	201.10	875.00
13	14	14	8	4,800	50.00	144.00
14	60	60	30	100,000	50.00	1,500.00
15	90	75	50	80,000	100.00	1,200.00
16	20	20	15	30,000	50.00	600.00
17	80	80	50	140,000	75.00	2,100.00
18	10	10	5	15,000	30.00	450.00
	815	641	428	1,274,830	$2,197.30	$20,368.50

*Twenty-four-hour business.

A disgruntled solicitor who has the habit of finding fault about occasional arbitrary decisions of the general manager regarding extensions will wake up some morning and find that an isolated plant has been installed and the business lost to the company.

In Table VI, item 6, is shown the residence business in prospect. It should be classified in such a manner that solicitors can go after it in sections, thus striving for lower cost of running service. This method offers a high degree of economy and has worked especially well in actual experience. Item 7, the downtown business, is sufficiently interesting and important to require a detailed sheet.

There are other sheets that could be included, the number depending upon the size of the company, the character of the city, etc. Where the company is branching out extensively into the suburbs, and transmitting long distances, there is usually considerable prospective business along the transmission lines which is always in mind.

When all the detailed sheets are ready they should be compiled in the form of one sheet like Table VI. Such a report furnishes to the head of the sales department the most detailed information. If he peruses it carefully the very first thought which comes to him involves a principle important to the company. He can encourage his solicitors to work more than

TABLE V.—EXTENSIONS, SLOW MOTOR PROSPECTS.

Customer.	Connected Horse-power.	Maximum Demand.	Average Horse-power.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income
1	50	45	25	90,000	$266.10	$1,575.00
2	100	60	40	120,000	900.00	1,800.00
3	150	60	50	100,000	828.00	1,750.00
4	300	125	75	250,000	1,353.00	3,100.00
5	200	150	125	300,000	75.00	3,130.00
6	100	90	25	25,200	1,000.00	504.00
7	100	90	25	25,200	500.00	504.00
8	300	280	200	1,200,000	2,800.00	1,2000.00
9*	50	50	50	300,000	500.00	3,000.00
	1,350	950	615	2,410,400	$8,222.10	$27,363.00

*Twenty-four hour business.

ever "on the lines." Next, whenever the subject of extensions comes up for his decision he will have the information in detail without question. How often he has been to the general manager for his advice about extensions when he did not have his story well learned, when he was asked questions that he could not answer! He had not yet become sufficiently clever to know that he ought to have had the information before he ever went to the general manager's office.

With this report system every bit of business is classified. If a solicitor hears of any new business it is placed on the report. He cannot so place it unless he has the facts. Hence the head of the sales department always has details before him for intelligent discussion of such extensions. Thus it is that

If the chief engineer is fearful that he cannot get through the fall season with the present load on account of low water conditions and inadequate steam facilities, then by all means push the residence business, the small commercial lighting deals, and keep away from the large motor users. If a season of hard times is just about showing itself and the directors say, "We should like to spend as little money as possible," this report at once becomes valuable. If a season of hard times has passed and money has become more plentiful, if the directors desire to push business more aggressively, the prospective report is not only valuable as a general guide, but it is helpful because of its detailed information.

How has the chief engineer heretofore determined the number and sizes of generators for which plans should be allowed? Oftentimes it has been more or less of a guess, and frequently based upon horse-power capacity. This report deals in hp-hours and the head of the sales department should learn to talk to his general manager in hp-hours. The chief engineer wants hp-hours, not horse-power.

In Table VI it will be noted, under commercial lighting, that there is $30,000 of business from the sale of the equivalent of 600,000 hp-hours; yet, in Table III, note, under "Service in, Slow Motor Business," that for $29,000 of business the company would have to furnish 2,541,000 hp-hours. It is plain to be seen that the character of business which the sales department must push depends upon the policy of the company and the condition of the generating system.

How true it is that the sales department may be big or little, depending upon how it is handled! The head of the department should assert himself and diligently strive to show the general manager the possibilities of the department. The sales department prospective report will become standardized and the general manager will depend upon it considerably for his recommendation as to purchases of increased generator capacity.

On the one hand, there is the sales department waiting on the engineering department. Sales of energy for motors are stopped and soliciting is done only on small lighting and motor deals. New apparatus is expected almost any time. The cooperation of the sales department with the engineering department at such a time preserves the dignity and the reputation of the company. It protects the company against making

TABLE VI.—STATEMENT SHOWING PROSPECTIVE BUSINESS, ANNUAL INCOME AND COST FOR EXTENSIONS AND SERVING.

Classes.	Connected Horse-power.	Maximum Demand.	Average Demand.	Annual Hp-Hours.	Cost Service Extensions.	Annual Income.
Service in, immediate prospects	350	950	615	406,400	$1,075.10	$6,749.50
On line, immediate prospects	219	191	154	264,500	1,142.50	4,519.00
Service in, slow prospects	2,550	2,205	1,940	2,541,000	5,433.50	29,192.00
On line, slow prospects	815	641	428	1,274,830	2,197.30	20,368.50
Extension, slow prospects	1,350	950	615	2,410,400	8,222.10	27,363.00
Residence business	450	275	208	166,666	5,000.00	10,000.00
Lighting, business district	1,500	900	600	600,000	7,000.00	30,000.00
Miscellaneous city extension	26	15	10	13,800	1,800.00	1,104.00
Miscellaneous motor addition	1,200	700	500	750,000	5,000.00	15,000.00
Suburban extension "A"	595	430	315	867,000	2,064.20	11,840.00
Suburban extension "B"	342	275	241	318,600	6,000.00	7,075.00
Suburban extension "C"	26	15	9	13,333	1,000.00	800.00
Suburban extension "D"	250	130	90	80,000	4,000.00	4,000.00
Suburban extension "E"	90	75	50	37,000	3,000.00	1,850.00
	9,763	7,062	5,326	9,743,529	$52,934.70	$169,861.00

the report is of much value to the sales department, to its head and to the solicitors. When the general manager sees it he is keenly interested. He has often patiently asked for just such information whenever deals were brought up before him for some opinion as to precedence of one over the other, or when the company could get to such a place with its lines, or exactly what expense would be involved. Now he can see at a glance the cost of service and the annual income. He is not only able to render a more intelligent opinion in connection with specific matters, but he can advise more intelligently than ever regarding classes of business which the sales department should favor.

contracts to serve customers which cannot be fulfilled. On the contrary the prospective report, which shows nearly 10,000,000 hp-hours in prospect and almost $200,000 business, makes the general manager think; it makes the chief engineer study; it creates a discussion among the directors, and sooner or later the sales department becomes the cornerstone of the central-station business.

The sales department manager has not only made his reputation by being thorough in this particular report, but he has established a system which will keep the department thorough in its plans and in its work. The solicitors are educated to be thorough. They have become more thoughtful than they were

before. They are better guided and directed than ever before.

Repeating a statement in the beginning of this article, it is commendable to exhibit aggressiveness in the sales department; activity and bustle are good for the public to witness; yet how much more pleasant and safe it is for the general manager to have in addition the feeling that the work each day is thoroughly well planned, that a system has been well laid out and approved by all. There is nothing haphazard about such activities. Aggressiveness following the inauguration of such a system will bring rich rewards.

Everyone realizes now how important is the sales department of the central station. Volumes have been written upon the needs of the department. Papers have been read setting forth how the solicitors should follow this and that class of business. A great many, if not all, of these suggestions, have been helpful to the central-station business. The object of this article, however, is to emphasize particularly the character of the report outlined; how easy it is to compile; how intelligible it is to the sales department head, to the general manager; and how valuable to the directors. Emphasis is placed upon the appropriateness of such a report at this season of the year. It represents the forerunner of all the work of the sales department. It is as essential to the proper operation of the department as gasoline is to the automobile.

The attention of the sales department head reading this article is called to the "Advantages of the Holding Companies" as set forth in a recent circular of a prominent securities company in New York. Advantage number two reads as follows: "Savings in operation due to comparisons of each minute division of expenses of the other companies." The traveling business manager of the large holding company would study this report carefully. He would arrange immediately to have such a report made uniformly by all the companies under his charge. Then each month, as the amount of new business is reported by each company, it would be shown not alone in dollars and cents, but also in hp-hours, and the cost of securing it would likewise be shown. It would not take long to detect which company was most earnestly striving for business "on the lines," or which company was most active in following the policies laid down by the big holding company.

First, it is of prime importance to know if a company has, besides other prospects, two different classes of business which it might go after, one which would produce an income annually of $30,000 from the sale of 600,000 hp-hours, and another class which would bring but $29,000 from the sale of 2,541,000 hp-hours. Second, it is exceedingly important to know the relative cost of handling both classes of business. The former deal would appear insignificant in the small amount of horsepower served, and the cost of installation and service might be more than for the business which appeared very important because of its large horse-power capacity.

These are only two cases mentioned. There are others continually arising in sales department practice among central stations. If the sales manager has such a report in front of him at all times, kept up to date continually by the different solicitors, he will know his business well and will do his business well for his company. Another advantage given in the circular issued by the securities company is as follows: "The beneficial spirit of co-operation and rivalry can be established between local managers." When sales departments of all the holding companies are equipped thoroughly with prospective sales reports, and the members of such departments are being governed by them in their soliciting, then will a higher degree of co-operation have been exercised in connection with the sale of electricity for lamps, heating appliances and motors.

With reference to the word "rivalry," which was used in stating the last advantage mentioned by the circular, the sales department, which gives particular attention to this kind of report, will approach the coming year with a feeling of pride. If there is only one station in the entire holding company which is using such a report, then it rivals the other companies. On the contrary, if other stations have likewise adopted the same kind of report, then opportunity is offered for rivaling them in the character of the report, and in the selection and securing of the business shown best to accord with the policy of the company as set forth by the general manager.

No sales manager who has once worked with this system will ever return to the methods which he formerly used. With the new prospective report before him at all times he will be able so to conduct his force that salesmen for all the other companies in the syndicate will be drafted from his department. Then will he have shown his ability to conduct a training school for operatives. Then will he be able to let men go from his department to take higher positions in some of the other companies without noticeable detriment to his own department and his own company. This is a feature which the large New York securities company is advertising as pertaining to it. Therefore it must be an important feature, because it is advertised to many thousands of prospective public investors. Such a report offers hope and encouragement for the future. Its careful perusal is accompanied by cheerful thoughts, and if there is anything which will make one sales department better than another it is to possess a higher degree of cheerfulness.

Wiring and Illumination

WIRING RULES FOR SAN FRANCISCO.

The Department of Electricity of the City and County of San Francisco has promulgated certain rules and regulations supplementary to the National Electric Code, which become effective March 1, 1911. According to these rules the installation of electrical conductors in wooden molding will not be approved. Service switches must be inclosed in an approved iron cabinet, provided with a glass door on which will appear the words "main service switch" in lettering not less than 1 in. in height. The service switch must be installed immediately within the main entrance of a building not provided with a basement having an entrance from the sidewalk, or not more than 6 ft. from the basement entrance of a building, and where appearance is a feature, the main service switch may be installed at the main switchboard or meter board and controlled remotely by a flush push button switch located in the main entrance. Wires from the controlling switch to the service switch must be installed in rigid conduit.

Feeder and service wires must always be of sufficient size to carry the lamp and motor circuits when these are loaded to their full capacity. In the case of lamp circuits this will mean 6 amp to each circuit installed. A two-wire service is called for where two circuits or less are run and a three-wire or convertible service is stipulated where more than two circuits and not more than six circuits are installed. The neutral wire of the convertible service must have a carrying capacity equal to the full load. A three-wire service of either the convertible or non-convertible type is specified where more than six circuits obtain. No service wires smaller than No. 12 are permitted.

In addition to the city ordinance, which provides that in the fire limits all wires used for conducting electricity, except those for telephone, telegraph and call-bell signaling systems, etc., shall be inclosed in conduit or other approved armor, the use of rigid conduit is made mandatory for feed wires to centers of distribution, motors, signs, reflectors, heating devices, resistance coils, low-voltage transformers or choke coils; wires for exits, entrances, fire escapes, halls, public toilets and baths, and lobby lamps in public halls or in hotels, apartment or office buildings of over two stories in height; service wires; wires on the exterior of buildings; wires to lamps outside of buildings when fed from concealed circuits; wires in theaters, nickelodeons, etc.; wires in elevator shafts; wires for basements, except where concealed in finished walls or ceilings; wires exposed to mechanical injury or flying combustible material; wires within 4 ft. of belts or pulleys; wires in or on marquises, and wires

in damp places, such as stables, breweries, hotel or restaurant kitchens, bath houses, etc. In all of the cases named the conduit must extend from the lamps, motors, etc., to the center of distribution.

Wires in flexible steel-armored conduit or steel-armored cable will not be approved on the exterior of buildings or in other damp places, or when placed in concrete or in channels in concrete or brick walls unless protected with a lead covering between the wire and the armor. The use of armored cables for concealed work will not be approved, unless installed in such a manner as to be readily withdrawn and replaced at any time without damage to walls, ceilings, floors or other portions of the building.

The installation of more than three No. 14 or more than two No. 12 or No. 10 wires will not be approved in a 2-in. conduit; nor will more than four No. 14 or No. 12 or more than two No. 14 or No. 12 duplex wires be approved in one 3¼-in. conduit. Conduit of a size sufficiently large to permit of the easy insertion and withdrawal of other numbers or sizes of wires must be provided. The use of any compound or lubricant other than soapstone is prohibited. In three-wire (not three-phase) systems the neutral fuse must be omitted and the neutral wire must have a carrying capacity equal to the larger of the outside wires. On standard 110-220-volt systems no installation of interior wiring will be approved with more than twelve sockets to the circuit, except in the case of border or foot-lights in theaters. The department will approve 10-amp fuses on 110-volt lighting circuits and 6-amp fuses on 220-volt lighting circuits.

In the interior of buildings the load on any 27-volt circuit must not exceed 12 amp, and No. 12 wire must be used. On the exterior of buildings No. 12 wire must be installed for each circuit and the load must not exceed 15 amp. No. 16 wire must be installed for four lamps or less in fixture work, and in fixtures having more than four lamps No. 14 or larger wire, as may be determined by the load, is called for. The rules provide for the installation of low-voltage transformers on the exterior and interior of buildings. When installed on the exterior of buildings the low-voltage transformer must be mounted on a marble slab or soapstone base not less than 1 in. in thickness and of sufficient size to extend 2 in. on all sides of the transformer, the transformer and base then being inclosed in a weatherproof iron cabinet painted to prevent rust and having at least three 1-in. holes in the bottom for ventilating purposes and provided with a self-closing door hinged at the top and fastened by a catch at the bottom. All wires must enter the cabinet through conduit, and a clearance of 3 in. on all sides, top and bottom, must be maintained. The transformer, slab and cabinet must be securely fastened to walls by screws, no part—device, slab or cabinet—being dependent on another for support. Transformers of heavily covered types will be approved without a cabinet, if installed on the frame of a sign or, on a slate base, if fastened to the building and the wires are brought within 3 in. of the point of entrance to the device in conduit provided with approved terminal fittings. On the interior of buildings low-voltage transformers must be installed in the same manner as upon the exterior, except that they must be located in the basement at some point where there is no probability of combustible material being piled against the device and with the additional precaution that an iron vent pipe not less than 2 in. in diameter shall extend from within the top of the iron box to some point on the exterior of building at least 2 in. from the surface thereof, the end of the vent pipe to be turned so as to prevent the entrance of rain.

Heating devices must be protected by cut-outs and controlled by indicating switches. The cut-outs must be placed at the center of distribution and at each outlet. This arrangement will necessitate running separate pairs of wires from the center of distribution to each outlet, fused at the normal capacity of the heating device, as shown on the name plate. The size, therefore, of these feeds can be determined only if it is known what type of heater is to be used and the maximum current consumed by the same. A red pilot lamp must be installed at each outlet and connected to the heater circuit, being operated from the same switch as the heater.

In closets used for the storage of wearing apparel or other combustible matter lamps, whether suspended from the ceiling or located on the side walls, must be equipped with an approved metal guard. In damp places the lamps, fixtures or brackets located within the reach of basins, bathtubs, sinks, washtubs or faucets must be protected with keyless waterproof sockets and be operated by a wall switch.

The schedule of inspection fees ranges from 5 cents for each outlet at which current is to be controlled or issued for four lamps or under to $2.50 for a generator of more than 15-kw output. Fifty cents is the minimum amount of any bill of fees to be charged. For service surveys of old electrical installations a maximum fee of $1 is charged, and where the time exceeds one and a half hours a fee at the rate of 75 cents an hour applies. It is necessary in order to obtain a permit to carry on electrical work for an authorized representative of the firm or individual proposing to do the work to file the requisite specifications in person, when a written permit will be issued. Applications by mail or telephone will not be recognized, and under the ruling of the joint board of Fire and Police Commissioners no electrical work can be performed without the permission of the Department of Electricity.

ILLUMINATION OF A MODERN FACTORY.

By Harry C. Spillman.

The rapid growth in the output of automobile factories in Detroit during the last few years has created considerable competition among the industrial engineers of these factories, each in his turn trying to outdo the others in factory equipment and installation. This competition has brought forth ideas of the highest grade, resulting in some excellent planning and installations in this kind of factory construction. The Hudson Motor Car Company's factory, which was recently completed, is without question one of the best of its kind, everything embodied in its design and equipment representing the very best and latest practice. The owners desired to bring the efficiency of this plant to the highest point and to make it the standard of comparison, and with this end in view a free hand was given to the writer in executing his designs.

The many details were so carefully planned and laid out that within eighteen weeks after starting the excavation the buildings were entirely inclosed and occupied and ten weeks later the entire factory was fully equipped, including the complete electrical and mechanical installations. This record relates to the entire plant, which consists of three large buildings of two floors, ranging from 400 ft. to 600 ft. in length and containing nearly 200,000 sq. ft. of floor space, besides a large office building, numerous small buildings and the boiler house from which the entire factory is heated. All the buildings are of reinforced-concrete construction, with steel sash, which makes them practically fireproof.

Special attention was given to the architectural appearance of these buildings and their surroundings, as the plant is located in one of the principal thoroughfares of the city.

Illumination proved to be the important problem, the result desired being equal distribution of light, avoiding glare, sharp shadows and the use of individual lamps at the benches, as there is very little vise work to be done in the factory. It was also desired to avoid the placing of lamps in the center aisle, which is used only for the trucking of material. To accomplish this a thorough study was made of the various lamps, fixtures, etc., on the market, the outcome of which was the use of 60-watt tungsten lamps in Holophane-D'Olier steel reflectors. The distribution curve for this lamp and shade gives practically a uniform circle of light 10 ft. in diameter when hung 8 ft. above the working plane, which is 30 in. from the floor for this class of work. The structural columns are placed 20 ft. apart, so that each bay measures 20 ft. square and contains four lamps placed on 10-ft. centers. From these figures and the

accompanying diagram it will be understood that there are four lamps for every 400 sq. ft. of floor space, which allows 0.6 watt per square foot of floor space in the side bays. As this illumination also takes care of the center aisle the actual luminous expenditure is decreased to 0.4 watt per square foot of floor area. This scheme of illumination has worked out so successfully that the intensity of light is far beyond expectations and photometer readings show that there is an average intensity of 3.1 ft.-candles at the working plane, with a variation of less than 0.3 of a ft.-candle. Calculations gave an average of 2.2 ft.-candles, but the walls, being white, doubtless

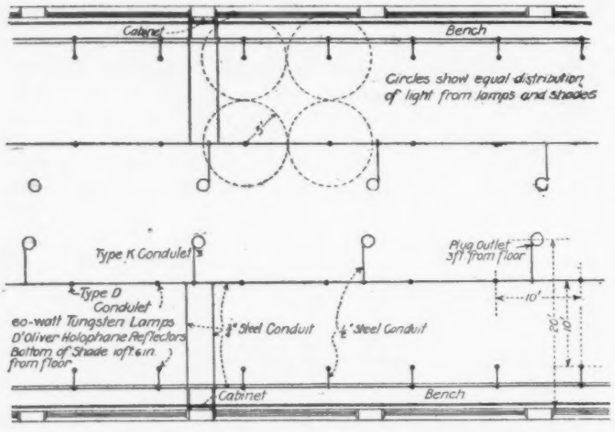


Fig. 1—Plan of Assembling Room, Showing Arrangement of Tungsten Units in Bays, Wiring, Etc.

are responsible for this increase. The middle aisle, which is 20 ft. wide and lighted entirely by the lamps in the side bays, shows an average intensity of over 2 ft.-candles, which is ample for trucking material. The layout as planned, therefore, gives excellent illumination without the addition of a single lamp.

As only eighteen months have elapsed since this company placed its first automobile on the market, showing its rapid growth, and as it is expected that the plant will increase with similar strides in the future, it was decided to purchase energy from the Detroit Edison Illuminating Company instead of building a power plant which, in all probability, would prove to be too small and inadequate in a few years. Electrical energy is purchased directly from the primary lines and passed through two sets of transformers having neutral taps on the secondary side and 5 per cent and 10 per cent taps on the primary side. One bank of transformers is used for power and the other for lighting service, so that any variation on the power circuits will not disturb the lighting voltage. The secondary leads from the transformers run to the distributing switchboard, from which the different circuits are controlled for the entire factory. All the circuits are in steel conduit, not a single wire being exposed, except drop cords to the lamps. In order to carry out this scheme successfully 5-in. steel conduit had to be used for a number of the circuits. Three-phase energy at 220 volts is used for motor service and 110-volt, single-phase energy is used for illumination, derived from 220-volt, single-phase, three-wire circuits led from the distributing switchboard to the lighting cabinets where all lights are controlled. The only switches outside of these cabinets are located in the hallways and toilet-rooms. The circuits to the lamps are run through ¾-in. steel conduits, each containing three circuits made up of No. 14 duplex wire. Two of these circuits each carry eight lamps, the reserve circuit being for plugs and future lamps. Condulet fittings are used throughout the installation, and in most cases a condulet is installed so that future extensions can be made if desired. The drop cord which leaves the condulet through a one-hole porcelain cover is of No. 18 reinforced black lampcord, known by the trade as "slicked." In addition to this, two outlets are installed on each column for extension cords. The wire used for this installation is double-braided, rubber-covered, containing not less than 30 per cent Para.

The drop in the feeders from the distributing switchboard to the cabinets shows 3 per cent when all lamps are lighted. The lamp circuits have an additional drop of 2 per cent, which gives a total drop of 5 per cent. This drop is nearly constant throughout the factory, varying less than 1.5 volts, so that only one type of lamp need be used, the 111-113-115-volt, 60-watt, clear-bowl tungsten lamp, which is burned on the middle voltage. There are about 1500 lamps throughout the factory, and they have been in operation about seventy-five days. Since they were installed considerable construction work has been going on, including the installation of a sprinkler system and the covering of overhead steam and water pipes, causing the lamps to receive a great deal of jarring, since the cords are connected directly to the circuits without springs or shock absorbers. Nevertheless, since the installation it has been necessary to renew an average of only 1.8 lamps per day, which shows a remarkably low maintenance on 1500 lamps.

A man inspects the entire installation every day, trying out each circuit. In case a lamp fails to burn, before removing it from the socket he gives it a slight jar or sway with a short stick, which allows the broken filament to fuse together, generally saving the lamp. As many as three filaments have been broken in a single lamp and the unit restored to successful operation.

The lighting for the office building was carried out under the same general scheme, with the exception that single-lamp metal fixtures are used, finished in statuary bronze to match the hardware, carrying focusing-type glass Holophane reflectors for the 60-watt lamps. These shades were sand-blasted inside,

Fig. 2—Lighting in Erecting Room, Showing Truck-Aisle Illumination from Lamps in Bays.

Fig. 3—Illumination of Engine-Fitting Room in Hudson Motor-Car Factory.

adding to their appearance and causing the reflector to give nearly the same distribution curve as the standard intensive-type shade. Each office has full control of its lamps by individual switches. The hallways are lighted by clusters of three 60-watt tungsten lamps in Holophane glass hemispheres and controlled by three-point switches. There are also scattered throughout the building baseboard receptacles which are used for dictaphone and desk-lamp connections. The annunciator and telephone systems are run in one steel conduit system having both baseboard and floor outlets. No. 18 rubber-covered wire is used for this purpose and as many wires as possible were pulled into each conduit so that in case future telephone or an annunciator connection is required the wires are all ready in place and the connection can be made in a very few minutes. It was found that ten of these wires could be easily pulled into a ½-in. pipe, twenty-eight into a ¾-in. pipe and forty-eight into a 1-in. pipe. More than 40,000 ft. of annunciator wire were required to fill these conduits. In order to

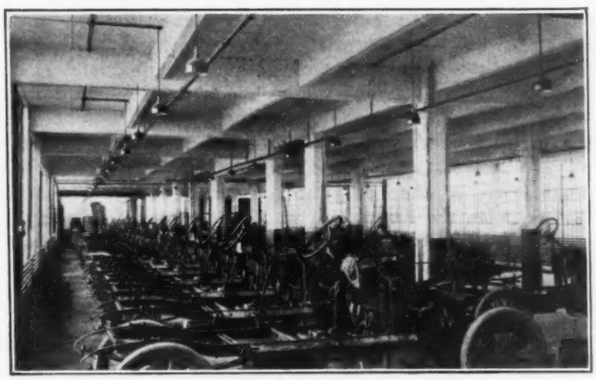


Fig. 4—Tungsten Lamps in Metal-Shade Reflectors, Used to Illuminate Assembling Room.

avoid long pulls two distributing boxes were placed on each floor and a 1-in. conduit extended from these boxes to the telephone and messenger room. Three-quarter-inch lines then connected these distributing boxes to the baseboard and floor outlets, which are connected together with ½-in. conduits.

The grounds are illuminated by means of twelve flaming-arc lamps mounted on 35-ft. iron poles, spaced about 300 ft. apart. The arcs are fed by No. 6 lead-covered cable and each lamp is controlled by a separate switch. It is found that this gives excellent yard illumination and as the carbons burn for a long period they demand very little attention.

The entire installation has proved very satisfactory and the illumination has attracted a great deal of attention and received many commendatory remarks. The general scheme is contemplated by other factories which are now under construction.

RECENT TELEPHONE PATENTS.

LOCK-OUT PARTY-LINE SYSTEM.

Multi-party lines have been in use since the very early days of telephony, and almost from their inception inventors have been devoting attention to the problem of selective signaling of the stations and the locking out of non-wanted stations. As far back as the early eighties efforts were made to operate harmonic ringing for twenty or more station lines and the step-by-step system was conceived about the same time. Of all the various arrangements proposed the most interesting are those employing the sectional-line principle. According to this method, the line is divided into sections from station to station and these are built up to form a continuous line between the desired stations, incidentally excluding intermediate stations. Such is the system patented by Messrs. C. A. Soans and A. H. Graves, of Chicago, and assigned to the Homer Roberts Telephone Company. In this system one wire of the line is continuous, while the other is in station-to-station sections with signal-conducting means bridging the gaps between sections. At each such gap there is a pole relay and at one end of the line is a central office. From the pole relays the drops or branches from the main line to the respective stations are carried. It will thus be understood that but two wires need be used for these station loops. The system is so arranged that a calling station sets a signal before the operator. The latter responds and sets the finding key, whereupon the calling line is automatically built up to the calling station through the response of one after the other of the pole relays. When a party is desired upon another line the operator plugs to that line and sets a sending dial to the proper number. This forwards sufficient impulses to build up the line to the desired station, whereupon ringing of that station automatically begins. The system includes equally simple means for restoring the lines to normal after a connection is completed.

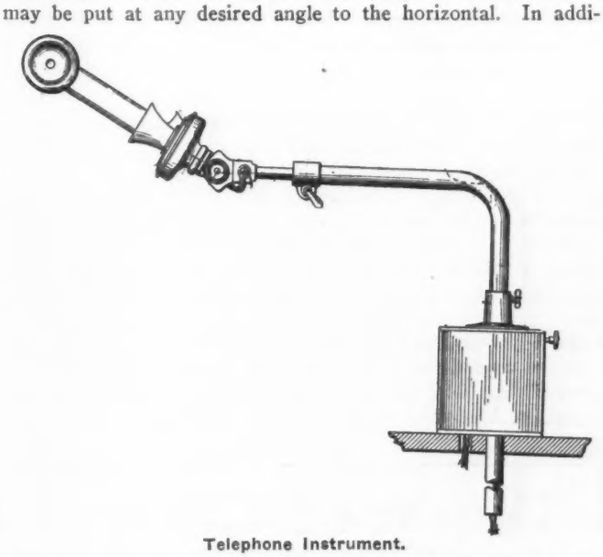
SIGNAL SYSTEM.

The system of Mr. S. S. Stolp, of Chicago, relates to a lamp-signal system. In this system calling is accomplished between stations by depressing a calling key which applies grounded direct current through a vibrating bell and a locking drop in multiple. The drop closes a lamp circuit from the main line to ground. The lamp is thus left glowing after a call until the drop is unlocked by a response at the telephone.

SWINGING ARM FOR DESK USE.

With the increasing use of desk telephones there arise more and more situations where the cords not only become a source of trouble from excessive wear, but in addition they become a nuisance to the user. For such situations the swinging and folding arms have been introduced. Most of these, however, while providing a fixed position for the main cord, make no provision for protecting the receiver cord.

For railway-dispatch work the cords have at times proved particularly troublesome, especially if these are mounted upon the desk telegraph and other instruments. For such situations Mr. S. L. Van Akin, Jr., of Liverpool, N. Y., has patented the set shown in the accompanying illustration. Such an arm completely protects the main cord and no receiver cord is necessary. The arm swings, is telescoping and the instrument may be put at any desired angle to the horizontal. In addi-



Telephone Instrument.

tion the receiver ear-cap is carried upon a ball-and-socket joint so as to conform to the face of the user. The hook-switch mechanism is contained within the housing at the base of the arm and it is operated by swinging the arm from mid-position.

SWITCHING APPARATUS.

A switching apparatus for intercommunicating systems forms the subject of a patent recently obtained by Mr. S. A. Koltonski, of Boston, and assigned by him to the Electro Mechanical Works. The chief feature lies in so arranging and assembling the parts that all plungers and levers of the keys are integral with the front plate, while all switch springs corresponding are mounted upon the back plate. The plungers may all be removed without disturbing springs or wiring.

Letters to the Editor.

Economy of Electric Fireless Cooking.

To the Editor of Electrical World:

Sir:—In the report in your issue of Feb. 2 of the address of Mr. E. W. Lloyd before the Chicago Electric Club on "The Market for Electrical Energy" reference is made to some remarks by the writer in the discussion of the address in which he is quoted as saying: "A meal for from five to nine persons could be prepared with the expenditure of less than 2 kw-hours." May I point out that this quotation is in error, the statement of the writer being that the electric fireless cookstove referred to "would do *all* the cooking and baking for a family of from five to nine persons with a maximum consumption of less than 2 kw-hours," and I further said, in explanation, that "a meal of bacon, eggs, toast, coffee and oatmeal could be prepared for five persons in less than thirty minutes with a consumption of less than ½ kw-hour"? As a further indication of the economy of electric cooking it may be added that with the same cooking outfit a consumption of 1200 watt-hours is sufficient for a meal consisting of two or three kinds of vegetables, pie or cake, roast beef, brown potatoes, gravy and coffee for five persons, all of which could be prepared between 9 and 12 o'clock with a maximum demand of 660 watts.

S. Phelps,
General Manager Electric Fireless Cookstove Company.
Buchanan, Mich.

Street-Lamp Ratings.

To the Editor of Electrical World:

Sir:—There are certain elements for grim amusement in connection with the measurement of candle-power of arc lamps and their ratings—especially their ratings for street-lighting purposes. While various correct and incorrect ratings are glibly applied to arc lamps, the fact is, as those who have done most in arc-lamp photometry well know, that all varieties of arc lamps vary so greatly in the distribution of light and in the consequent candle-power obtained at any one point, that it is only by a long and tedious series of measurements that one can even approach a correct rating for any given lamp. The humor of the situation is that while an arc lamp may be rated to give a certain candle-power at a given angle below the horizontal the real average value may only be obtained once out of many readings, as the light is varying from far below to far above the average. When the open or inclosed carbon-arc lamp is used for interior lighting the variation caused by the wandering of the arc around the carbon tips is not so serious as in the case of street lighting. Most interiors have fairly light walls and ceiling, and the reflection from these helps to counterbalance the variations in light as the arc wanders around the carbon ends. In street lighting, however, there is but little reflection from buildings and surrounding objects to help out the illumination when the arc happens to be on the opposite side of the carbon tips from the observer.

Here it is very pertinent to raise the question whether the minimum illumination obtainable should not have an important bearing on the practical rating of a lamp rather than to take unqualifiedly an average obtained only after hundreds of carefully taken observations. The non-technical man naturally asks the question at once as to what good the illumination above average does him when it is really the minimum illumination he obtains which governs his ability to see his way along the street. On the other hand, it would hardly seem fair to the arc lamp to rate it according to some very low candle-power readings obtained occasionally under unusual conditions. Nevertheless, it must be admitted that if one had two lamps which gave an equal average candle-power in the direction most useful for street-lighting purposes, and one of these lamps varied greatly above and below average, while the other operated at all times very close to the average, he would unhesitatingly select the lamp with the least variation.

One practical bearing of this point at the present time is in connection with the substitution of large series-tungsten lamps for carbon-arc lamps in the smaller towns. As a specific example of this we may take the case of the 6.6-amp inclosed, alternating-current, series-arc lamp as compared to a 250-watt series-tungsten lamp equipped with proper reflector. According to the arc-lamp ratings in the reports of the 1907 and 1908 committees of the National Electric Light Association the effective candle-power of the arc lamp referred to (measured at a distance from the lamp equal to about ten times its height) is 196. Making due allowances for the depreciation caused by dirt on the tungsten lamp in practice, and also for the increase in effective candle-power caused by the reflector, one would expect the two lamps to be about on a par for street-lighting purposes. When one considers, however, that the tungsten lamp gives a steady light, while the average figure named for the arc is really one obtained by readings varying far above and below the figure named, the tungsten lamp comes out decidedly ahead in the comparison. Carrying the comparison a step further, it is doubtless true that the 250-watt tungsten lamp referred to could be satisfactorily substituted for arcs of somewhat higher rating than the 6.6-amp inclosed series arc.

In making all substitutions of this kind at the present time, however, central-station companies should bear in mind the troubles which have arisen in the past through the substitution of one kind of lamp for another without formal authorization by city officials. It is always best that these matters be fixed definitely and in due form and that specific permission be granted to substitute a certain specific lamp for the one in use. In doing this it is well for the company to state its case fully, making no secret of the fact that there will be advantages to the company in making the change if there be such advantages in the specific case under consideration. Such changes should be asked for on the ground of mutual advantage to city and company, such advantage being made possible by recent improvements in the electric-lighting field.

Chicago, Ill. Charles L. Tremaine.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Paralleling Alternators.—A note on a recent British patent (22,224, Jan. 26, 1911) of Siemens Brothers & Company for an instrument for indicating equalizing currents of alternators in parallel. The primary coils of a current transformer are inserted in series between the common busbars and the circuit of similar phase of each generator, and the secondary coils are connected in series with one winding of the phase-difference indicator of that generator. The other winding of the phase instrument is traversed by the resultant current due to the sum of the separate currents flowing in these secondary coils.—Lond. *Elec. Eng'ing*, Feb. 2.

Reversing of Polyphase Motors.—A note on a recent British patent (28,661, Jan. 26, 1911) of the Siemens-Schuckert Company. To avoid sparking at the switch contacts and heavy rushes of current when reversing three-phase induction motors of low frequency the field is maintained near its full strength during reversing by first short-circuiting the two phases to be reversed at the instant when they are at equal potential.—Lond. *Elec. Eng'ing*, Feb. 2.

Lamps and Lighting.

Arc Lamp.—A note on a new arc lamp of Ruhling which is very similar to the old Jablochkoff candle, but has a new feature which renders it self-starting. As in the Jablochkoff candle the two carbons are parallel, and are separated by a strip of non-conducting plaster, and a metallic bridge is provided for starting the arc. In the original lamp, if the current is interrupted, the arc cannot restart without restriking by hand; but in the new lamp a certain amount of powdered copper is incorporated in the plaster, and when the arc goes out a film of copper is deposited across the plaster and forms the necessary bridge for restarting the arc. The reducing effect of the carbon in the arc prevents the copper from oxidizing. The lamp can be used in any position—vertically upward like a true candle, horizontally, or with suitable carbons pointing vertically downward in an economizer, with a blow-out coil, as a flame lamp. In the first two cases absolutely no mechanism is required, and in the flame lamp the very simplest device is sufficient to permit the carbon to feed against a stop as burned away. The sizes of the two carbons in the continuous-current lamps are proportioned so as to burn away at an equal rate and a steady light can be obtained with a current as low as 2.5 amp to 3 amp. The candle-power curve of Fig. 1 shows that the candle-power is a maximum in the axial direction,

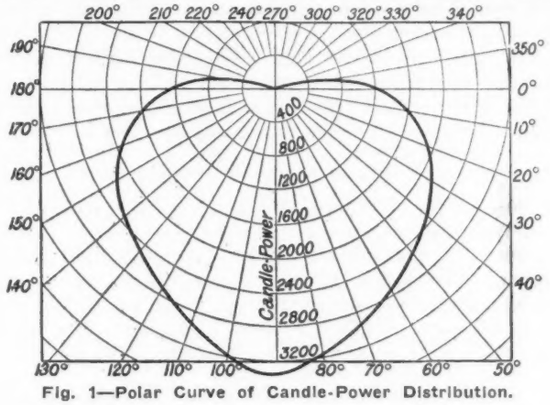


Fig. 1—Polar Curve of Candle-Power Distribution.

which would indicate that, with the carbons nearly horizontal, a distribution of light not unsuitable for street lighting can be obtained.—Lond. *Elec. Eng'ing,* Feb. 2.

Flame-Arc Lamps.—A note on a recent British patent (12,483, Jan. 26, 1911) of the Siemens-Schuckert Company. In order to remove the fumes from the globe of a flame-arc lamp an annular passage with outlets in the upper part of its outer wall is provided above the globe. Screens or rotary cowls are fixed outside over these openings, so that wind striking the lamp may set up a suction effect.—Lond. *Elec. Eng'ing,* Feb. 2.

Generation, Transmission and Distribution.

Industrial Networks.—J. R. DICK.—The voltage drop in the mains is not of such importance in industrial networks as in lighting networks. It does not unduly affect the efficiency of motors, although it reduces the working speed, but this can be allowed for, in relation to the machinery operated, by adjusting the ratios of the driving gears. With synchronous or induction motors the speed is independent of the pressure drop in the distributing system as long as the frequency is kept constant. The question of speed regulation is of great importance in many instances, such as the textile, and in no application of electric driving is it negligible. Polyphase motors exhibit a decided advantage over direct current in respect to constancy of speed. In the majority of installations up till now the same mains furnish both motor service and light, but for industrial areas, where it is hoped ultimately to satisfy practically every demand for power by electrical means, it is at least worth considering whether it would pay in such cases to put down a separate network for motor service. There is every probability that the price of electric energy could be made substantially smaller than with a common network. The design of an industrial network is usually dependent on the condition that the energy lost in the mains should not exceed a certain proportion of that usefully employed up to a limit of, say, 10 per cent, and the maintenance of a constant pressure within 2 per cent or 3 per cent limits is practically ignored. The author shows by mathematical analysis that the current density, to satisfy the condition of minimum volume of copper in a system of mains characterized by a definite percentage of loss of power, must be constant throughout, or conversely, if a constant-current density is used, the amount of copper will be a minimum. Kelvin's law is a particular case of the general law of "constant-current density." The rigorous application of the principle of a constant-current density involves a change of cross-section at every point where an installation is connected to a long length of main. But it is possible to find an average current in the main, if a constant cross-section be taken (as is customary in practice), which will give the same loss of power.—Lond. *Electrician,* Feb. 3.

Electric Power in Potash Mines.—BALDAMUS.—The development of the German potash industry has been going on simultaneously with the development of electrical engineering. The present article gives an interesting historical review. In 1883 the potash industry had four small separated stations of together 70 hp, which also supplied lighting. At present the potash works have a most up-to-date electrical equipment for all purposes of mining, lighting and industrial purposes in general. They have stations of more than 1000 hp and buy energy up to 6000 hp from other plants. The potash industry has been a good consumer of the German electrical manufactures and has been equipped in return with the best electrical machinery. —*Elek. Zeit.,* Feb. 2.

Alternating-Current Elevator Motors.—W. H. PATTERSON.—An article on the use of induction motors for elevator service. The wound-secondary induction motor has high starting torque characteristics and speeds satisfactory for operating elevators of all capacities up to a maximum speed of 250 ft. per minute. Elevators operating at higher speeds are practically always two-speed machines and this feature immediately eliminates the alternating-current motor from a practical standpoint, as with any given amount of resistance inserted in the rotor circuit the speed will vary with the load. Thus, on high-speed elevators running from 250 ft. to 600 ft. per minute, direct-current motors are always used. Another feature that limits the use of alternating currents to elevators operating at speeds of not over 250 ft. per minute is that in order to accomplish dynamic breaking of an induction motor for automatically slowing down the elevator car a small motor-generator set is necessary to supply direct-current excitation to the primary. Therefore, in driving all modern high-speed electric elevators direct-current motors are used. Squirrel-cage induction motors require no controller, as they are not connected directly across the line. A drum-type reversing switch is used to control the direction of rotation. A controller for use with polyphase slip-ring elevator motors is also described.—*Elec. Journal,* February.

Electricity in Steel Mills.—B. WILEY.—An article illustrated by diagrams with special reference to the different systems for electrically driving the main rolls of steel mills.—*Elec. Journal,* February.

Electric Heating and Cooking.—H. GRAY.—The author first describes a number of tests on gas-heated apparatus and electric utensils to ascertain the efficiency and comparative cost of use. He then discusses the design of electric apparatus and finally future developments. In electric cooking there is some difficulty in attaining a practical uniform heat round all parts of the food, particularly in big sizes of ovens. The arrangement adopted by the author is to generate the heat at the bottom, deliver it then into vertical "flues," the flues passing it into the oven proper at the top. The hot air is then forced from the tops by fresh hot air continually rising in the flues—through all the area containing food—to the bottom, where it again comes in contact with the heating elements and the process then repeats itself. Fig. 2 shows the direction of the air currents in a diagrammatic manner. The circulation of air from top to bottom is absolutely certain as long as heat is being generated, and there is a slight wastage of heat always

going on, due to absorption of heat by the food and heat leakage, which tends to make a slight reduction in the temperature of the air as it moves from the top to the bottom. This difference in temperature in practice is found not to exceed 15 deg. Fahr. when cooking temperature is attained, and with this difference the speed of the air is quite sufficient to sweep away all "air-locks" from the top and around the food. This slight temperature variation, which is not 5 per cent of the total temperature, is not sufficient to affect practical uniformity of cooking from top to bottom of the oven. With regard to retaining the heat in the general body of the oven the general practice is now to have the oven double-jacketed with the

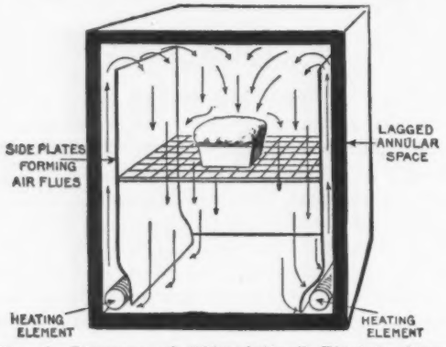


Fig. 2—Diagram of "Circulating" Electric Oven.

hollow walls filled with dry air retained in a cellular state by means of finely divided asbestos or slag wool. Both of these materials give excellent results if the jacket is made 1½ in. to 2 in. thick. A charge of over 2 cents per kw-hour will generally confine the use of electrical cooking to the well-to-do people, with whom the somewhat increased cost over gas or coal is negligible compared with the advantages obtainable. At 1½ cents per kw-hour, and with apparatus turned out in quantity, nothing should in the future stop great developments. An account of the long discussion which followed is also given.—Lond. *Electrician,* Feb. 3.

British Central-Station Statistics.—Tables completing the annual statistics on the connections to British central stations supplying only lighting and motor load and to stations taking a bulk supply and stations having combined lighting and traction loads respectively.—Lond. *Electrician,* Jan. 27. These statistics are now summed up in several diagrams and tables. For the City of London stations (total connections 385,391 kw) the figures are as follows:

Municipal.	Companies.
D. c. 59,685 kw	D. c. 76,904 kw
A. c. 32,278 kw	A. c. 27,322 kw
Mixed 26,994 kw	Mixed 142,208 kw
118,957 kw	246,434 kw

For the provinces (total connections 1,106,886 kw) the figures are as follows:

Municipal.	Companies.
D. c. 366,138 kw	D. c. 92,797 kw
A. c. 123,706 kw	A. c. 26,600 kw
Mixed 425,819 kw	Mixed 72,826 kw
914663 kw	193,223 kw

In 1909, for the first time, the connections to the provincial stations exceeded 1,000,000 kw and the rate of increase was well maintained during 1910.—Lond. *Electrician,* Feb. 3.

Fool-proof Devices.—A general discussion before the West of Scotland Branch of the (British) Association of Mining Electrical Engineers on the function of fool-proof devices. W. A. Wilson started the discussion and emphasized that the expression "fool-proof" should be confined solely to such apparatus as may have to be handled by fools by reason of their vocation; but that the apparatus to be handled by skilled men should only have such devices attached to it as will protect men who are thoroughly conversant with their working and will in nowise hamper the skilled attendant or render the apparatus accessible with difficulty. His reason for suggesting that there should be such limitation is that there appears to be a growing tendency to surround all electrical gear with devices and safeguards, the principal object of which appears to be the preservation of human life irrespective of whether or not it interferes with the action of the trained engineer or the industry for whose benefit he works. It is doubtless proper to have electric switch gear at the working face of a mine, which is in daily use by men skilled in the winding of coal, so protected as to preclude, if possible, the chances of a shock. It is equally proper to insist that a fuse on a switchboard shall not be in such a position as to damage the eyes of the attendant in carrying out his duties. But it is different in purely electrical installations with which only electricians come in contact. D. Martin said that there were not so many fools as ignorant men, and an ignorant man should be educated to such a standard that he would realize that if he increased the capacity of the fuses, for example, he jeopardized the life of the coal-cutter or haulage motor. Unquestionably the miner inevitably, by reason of his vocation, became a more or less reckless man.—Lond. *Electrician,* Feb. 3.

Variable-Speed Driving Gear.—A note on a recent British patent (30,556, Jan. 26, 1911) for a variable-speed polyphase driving gear for ships, etc., granted to H. A. Mavor, H. M. Hobart and Mavor & Coulson, Ltd. This patent covers a system in which two or more motors with means for varying their pole numbers are supplied with currents of different phase numbers and frequencies from two or more generators. At maximum load all the machines and the different windings are used at their full capacity without interfering with each other. An important feature is that synchronizing of the generators is avoided.—Lond. *Elec. Eng'ing,* Feb. 2.

Wires, Wiring and Conduits.

High-Pressure Transmission Lines.—R. B. Matthews and C. T. Wilkinson.—A paper read before the (British) Institution of Electrical Engineers. There is no engineering difficulty which will prevent the building of transmission lines of great length, but financial considerations may at present limit the length to 400 miles. For transmission systems steel towers and suspension insulators have practically replaced wooden

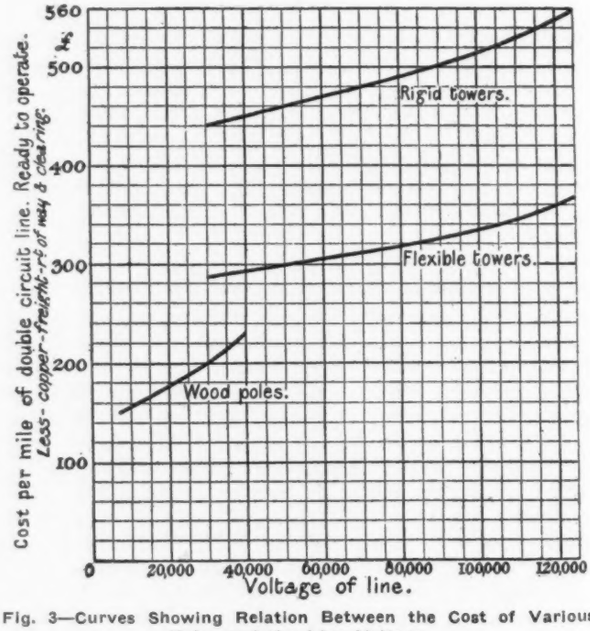


Fig. 3—Curves Showing Relation Between the Cost of Various Poles and the Line Voltage.

poles and pin-type insulators. Flexible structures, too, are taking the place of rigid systems. Fig. 3 shows curves which can be taken as fairly representative of the cost per mile for a given voltage. The costs are independent of the conductor, but include the cost of the pole or towers and their erection and that of the wires. It is not practicable to build a wood-

pole line for above 40,000 volts for two circuits, since the length of the cross-arms becomes excessive. Further, the cost curve slopes up somewhat steeply, and in the neighborhood of 50,000 volts would cross the flexible tower curve. The latter means a construction with an average life of thirty years, whereas the wood-pole line can only be assumed to have an average life of twelve years. Figs. 4 and 5 give useful data with regard

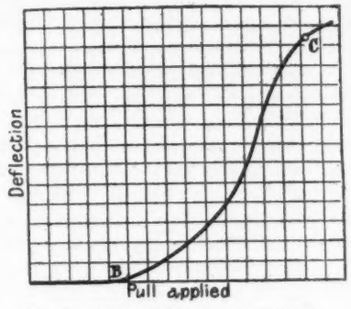


Fig. 4—Yield of Earth Foundation.

to the yield of the earth foundation and the sag of the wire between supports on the pole line. Interruptions to service may be divided into three classes: Mechanical failure, mechanical failure following electrical causes, and wilful damage. The chief contributor to the first cause may be expected to be ice. Ice forms equally freely on wires whether they are alive or dead up to an operating voltage of 66,000, above which no reliable information is obtainable. Mechanical failure may occur from electrical causes, such as heavy short-circuit and lightning discharge. Care should, however, be taken to study

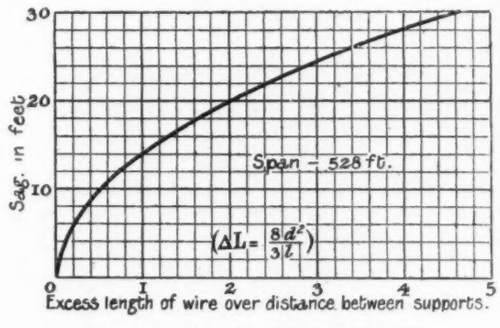


Fig. 5—Sag of Wire Between Supports.

the topography of the country before constructing the line and even to build two separate lines. Earth wires and lightning rods are of undoubted value, and the tower should be earthed. A liberal factor of safety should be allowed on the insulators and ample spacing should be given to the wires. An ingenious system for the protection of highways and railway crossings is to support the span immediately on either side of the railway or highway, and the spans on either side of this crossing span are of extra length. The two crossing poles carry the necessary insulators, etc., but the wire is not tied tightly to them, but is supported in such a manner that in case of breakage it will readily slip through and be pulled clear by the longer spans.—Lond. *Electrician*, Feb. 3.

Electrophysics and Magnetism.

Atomic Nature of Electricity.—F. EHRENHAFT.—The author discusses the recent investigation of R. A. Millikan, who concluded from his experiments that electricity has a corpuscular nature and that the electric charge of the corpuscle is 4.9×10^{-10} electrostatic units. He, himself, had concluded from his own experiments, carried out with the aid of the ultramicroscope, that some particles carry smaller charges. He points out that Millikan did not investigate particles as small as he did himself with the ultramicroscope. He finds that it is just these exceedingly small particles, with a radius below 3×10^{-5} cm, which carry charges smaller than the so-called electronic charge. He criticises Millikan's modification of Stokes' law according to Cunningham's formula. He still maintains that it is not proved that there exists a minimum electronic charge of the order generally given.—*Phys. Zeit.*, Feb. 1.

Electronic Theory.—L. T. MORE.—A critical discussion on the recent theories of electricity. The author wants to overcome the difficulties between the old and the new theories of the following hypothesis: He proposes that in order to make the ratio of the electric charge e to the mass m of the corpuscle agree with the experimental evidence of its value and to account for electromagnetic mass, m may be considered the mass of a particle of matter in the Newtonian sense of constant and small value, and the e, electrical charge, to be a force attribute of matter which varies with the velocity of the particle.—*Phil. Mag.*, February.

Electromagnetic Pulse Theory.—C. G. BARKLA AND T. AYRES.—The authors emphasize that experiments on the phenomena of scattering of X-rays furnish what appears to be the strongest evidence in support of the electromagnetic pulse theory. They describe experiments showing the remarkable agreement between the pulse theory and experiment under limited conditions.—*Phil. Mag.*, February.

Rays of Positive Electricity.—J. J. THOMSON.—An account of experiments of positive rays made with very large discharge tubes. At very low pressures he found that the patterns on the phosphorescent screen produced by the positive rays after they had passed through electric and magnetic fields were separate parabolic curves. In all these experiments the rays were detected by the phosphorescence they produced on a willemite screen. The author endeavored to apply photographic methods to the study of these rays and was especially successful after putting a photographic plate inside the tube itself and letting the positive rays fall directly on the plate instead of onto the willemite screen. The arrangement of the apparatus is described in detail and the photographs taken by this method are analyzed and discussed in detail.—*Phil. Mag.*, February.

Thomson Effect.—P. CERMAK.—An account of measurements of the Thomson effect in lead, mercury, tin, zinc, cadmium and aluminum; the effect has been found extremely small, but never constantly nothing. In the transition from the solid to the liquid state the curve representing the Thomson effect is a continuous one, while that representing the change in resistance is a broken one.—*Ann. der Physik.*, No. 16, 1910, pages 1195-1215; abstracted in *Amer. Jour. of Sciences*, February.

Scattered Röntgen Radiation.—J. A. CROWTHER.—A note on his recent British Royal Society paper in which he gave an account of experiments made to determine what fraction of the incident radiant energy was scattered per unit mass of a radiator when primary Röntgen rays fell upon it. From the numbers obtained a value was deduced for the number of electrons per atom of the radiating substance. The value obtained agreed closely with that previously deduced from experiments on the scattering of homogeneous beta rays, being very nearly three times the atomic weight of the substance. The distribution of the scattered radiation was measured. It reached a maximum forward and backward along the line of the primary beam and fell to a minimum at right angles to this direction. At any given angle with the primary beam there was always a preponderance of scattered radiation in the forward direction. The preponderance increased the more nearly the line of the primary beam was approached.—Lond. *Electrician*, Feb. 3.

Crookes' Dark Space.—F. W. ASTON.—A note on his recent Royal Society paper on the distribution of electric force in Crookes' dark space. The method used in the investigation was one due to J. J. Thomson and consisted in shooting a beam of homogeneous cathode rays transversely through the discharge and observing the deflection of the beam at various points. The results so obtained were free from the very serious objections which might be urged against the "sounding-point" methods used by previous observers. The electric force in the negative glow was found to be negligibly small, while

within the Crookes dark space it was satisfied within experimental error by the simple formula $\mu(D-X)$, where D is the length of the dark space, X the distance from the cathode and μ a constant. The result indicated the presence of a uniform charge of positive electrification within that region. The distribution was the same for all gases, pressures and currents used. By integrating the forces so obtained the potential fall across the dark space was calculated and was found in all cases to agree, within experimental error, with the actual potential between the electrodes. The large and abrupt fall of potential at the surface of the cathode found by other investigators was probably a result of faulty methods, an explanation of which was suggested.—Lond. *Electrician,* Feb. 3.

Electric Dust Figures.—J. Robinson.—A brief paper referring to the recent observation of Richmond on dust figures obtained by the passage of electric sparks at the end of a Kundt tube. The present author shows that it is hardly possible to maintain the electrical theory of this phenomenon. It seems more probable that the cause of the ripples lies in the sound of the spark and that they resemble the ripples between the nodes in a Kundt tube rather than the nodes themselves.—*Phil. Mag.,* February.

Units, Measurements and Instruments.

Simplicity in Measures.—C. Hering.—An article on simplicity in the measures of physical quantities. The author gives a critical analysis of the present systems of measures and units and of the interrelations between the different groups of units. He shows by examples that many of the numerous every-day calculations of the engineer, which must be made with such units, could have been greatly simplified and their clear understanding facilitated and enhanced had the systems by which some of these units were originally designated been more rational and consistent ones. While it is admitted that it might be too revolutionary to change our present irrational system to the rational one by a complete and radical transformation, yet this very desirable change, which is bound to come in time, could be greatly encouraged and accelerated by continually keeping the ideal system in the mind, teaching it to students and approaching it at every possible occasion by small but positive and decided steps in the right direction, and by all means not making existing matters worse by taking any steps in the wrong direction away from this path to the ideal. A close approximation to this ideal system is already in extended use among physicists under the name of the c.g.s. system, and there appears to be no reason why engineers, who apply physical laws to practical problems of construction, should not also enjoy the advantages of similar simplicity in their practical work.—*Jour. Franklin Inst.,* February.

Energy Losses in Condensers.—J. A. Fleming and G. B. Dyke.—An illustrated article on the measurement of energy losses in condensers traversed by high-frequency electric oscillations. The authors describe an arrangement which they have devised for measuring condenser losses in a high-frequency circuit, a modified form of Peukert discharger being employed. The results show that in all cases the equivalent resistance increases with the condenser current. Measurements of the energy losses are given for a large number of condensers and exponential formulas have been obtained.—Lond. *Electrician,* Feb. 3.

Telegraphy, Telephony and Signals.

Long-Distance Telephone Circuits.—Abstracts of a large number of written communications contributed on the recent paper of O'Meara before the (British) Institution of Electrical Engineers. B. S. Cohen stated that a large number of elaborate tests had been carried out in different countries to find out whether there was any one single frequency which would give results when used both for calculating and for direct experiment which would be in agreement with those results obtained by actual speech measurements. The methods adopted in carrying out these experiments had varied considerably and yet it was noteworthy that the results obtained were invariably in close agreement in showing that a single frequency of the order of 800 was the correct figure. This was as far as the volume factor of audition was concerned. F. Jacob proposed the term "space loadance," in contradistinction to "continuous loadance," to describe the condition of self-inductance as obtained with coils and continuous iron-wire winding respectively. Leakage must be considered as a property of a dielectric which has not a function of its insulation resistance.—Lond. *Electrician,* Feb. 3.

Wireless Telegraphy.—H. A. Hall.—An article referring to the use of carborundum, galena and other crystallic rectifiers in wireless telegraphy. The author proposes to use an intensifier constructed similarly to a magneto, but, of course, dispensing with the field magnets and in their stead having many turns of wire wound to a high resistance and a finely laminated core in the armature, the poles of which are connected to the make-and-break M and rubbing contact P respectively (Fig. 6). The idea of the make-and-break in this

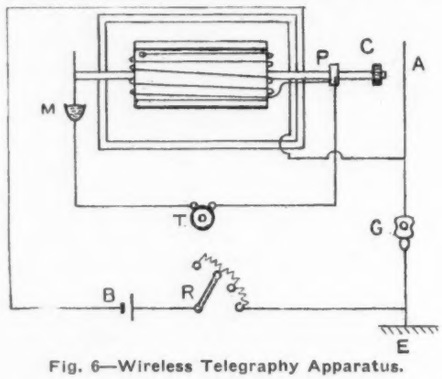


Fig. 6—Wireless Telegraphy Apparatus.

intensifier is to make contact when the armature is in the strongest part of the field; otherwise we should expect to receive an approximately uninterrupted sine curve. The make-and-break consists of an iron trough filled with mercury into which dips a steel needle. In an experimental apparatus it was found that at each make-and-break a distinct click was heard in the telephone receiver T, due undoubtedly to the contact of different metals. Barring this one small flaw the receiver gave great satisfaction. The intensifier is placed in an iron box so as not to be directly susceptible to outside influences, such as the earth's magnetic induction. The armature is rotated at high speed by clockwork through the pinion C; A is the antenna, G the rectifier, B the battery and R a variable resistance.—Lond. *Elec. Review,* Jan. 13.

Book Reviews.

Automobile Mechanician's Catechism. By Calvin F. Swingle. Chicago: Frederick J. Drake & Company. 110 pages. Price, $1.25.

The 400 questions and answers which make up the text of this handbook cover the various details of automobile construction, operation and repairs. The questions are arranged in alphabetical order by the subjects of which they treat. Thus, the first page opens with questions on acetylene, asking about "inconveniences connected with the use of acetylene light." True in automobile lighting as in interior illumination, the drawbacks mentioned are: Acetylene "contains impurities which endanger the health when burned in a closed room. Carbon dust gets into the burners and clogs them, sometimes causing explosions. In order to get satisfactory operation from such a system, * * * strict cleanliness must be maintained, and various parts examined and replaced from time to time as becomes necessary." The arrangement of ignition and fuel-feed systems and the symptoms and repairs of automobile troubles are also explained.

BROOKES' AUTOMOBILE HANDBOOK. By L. E. Brookes. Chicago: F. J. Drake & Company. 701 pages, 321 illus. Price, $2.

This manual is intended to serve as a text-book for the instruction of owners, operators and repairmen of automobiles. Most of the reading pages are devoted to the gasoline car, due attention being given to the ignition circuits, batteries, magnetos, commutators, distributors, etc. Reference is also made to the electric vehicle, giving brief instructions for the care and operation of lead-cell storage batteries, charging circuits, etc. The details of mechanical construction gone into in the case of the gasoline and steam cars also apply, to a degree, for electric automobiles. In spite of the presumed up-to-date character of the work it is surprising to note on page 270 a word of warning expressed against the use of electric lighting of automobiles. Overlooking the thousands of low-voltage tungsten lamps already in satisfactory use on gasoline cars, the author writes: "It is well to remember that electric lamps consume a great deal of power. One 16-cp lamp requires about 1/12 hp to operate it, the electrical energy per candle-power being a trifle over 4 watts." Of course, the 16-cp tungsten lamp, operating at a specific consumption of 1.25 watts per candle-power, takes only 20 watts, or about 1/37 hp, and is even more economical, as well as infinitely safer and cleaner, than acetylene, oil or other illuminant. Moreover, an automobile does not require a unit as large as 16 cp.

JOURNAL OF THE MUNICIPAL SCHOOL OF TECHNOLOGY, MANCHESTER, ENGLAND. Vol. 3, 1910. 392 pages, numerous illustrations.

This volume is the third of a series of annual compilations of investigations undertaken by members of the teaching staff and students of the School of Technology, Manchester, England. Some of these investigations are in the nature of essays, while others are extensive experimental researches. An idea of the type of studies can be obtained from the following list of electrical subjects. "Flash-over Voltages"; "Electric Traction Vagabond Currents"; "The Design of Small Direct-Current Machines"; "Notes on Elimination of Sparking"; "The Utilization of Exhaust Steam for Electric Driving." These are six out of the total of thirty-four studies recorded. The subjects relate to steam engineering, mechanical engineering, electrical engineering, physics, chemistry, archæology and textile industry. Unfortunately, nearly all the work is expressed in English units instead of in metric units, so that a valuable book like this is virtually a secret document to all workers outside of England, her colonies and the United States. The notation should be the combined English and metric.

ELEKTRISCHE UHREN. By A. Tobler. Second edition. Edited by Johannes Zacharias. Leipzig: A. Hartleben. 255 pages, 120 illus. Price, 4 marks.

This is a revision of an early volume of the publisher's celebrated electrotechnical series. The subject of electric clocks has so developed since the appearance of the first edition that the subject of fire telegraphs has been dropped to make room for the largely increased amount of material on electric time mechanisms. The subject is divided into three parts: The description of various time-marking devices, which occupies two-thirds of the book; time telegraphs; electric chronometers, and a chronological list of inventors of electric clocks patented in Germany between the years 1877 and 1909. The work is very complete and is well illustrated. It should be a valuable reference on the subject of electric clocks.

THE PRINCIPLES OF ELECTRIC WAVE TELEGRAPHY AND TELEPHONY. By J. A. Fleming. Second edition, revised and extended. London: Longmans, Green & Company. 906 pages, illus. Price, $7.50.

This well-known textbook on wireless telegraphy has undergone considerable extension in its second edition. The work is not only a comprehensive treatise on the principles underlying wireless telegraphy, but also a history of the development of that art and an exposition of the apparatus used in it. A brief chapter on wireless telephony has been added. The work will be invaluable to technical students of wave telegraphy and of applied electric radiation.

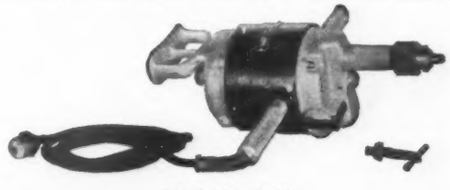
ELECTRIC TRACTION ON RAILWAYS. By Philip Dawson. London: The Electrician Company. 855 pages, 606 illus. Price, $9.

This is a textbook on electric railways especially as built and operated in Great Britain. The book commences with a brief historical description of the evolution of electric railways. It then considers fundamental dynamical relations and the types of electric motor and system. The engineering theories of various types of motor are developed in their simplest terms. Construction and methods of operation are dealt with in a very practical way. The power plant and the substation each receive a separate chapter. "Repairs" and "Financial Considerations" are the titles of the two concluding chapters. The book is well and copiously illustrated and also well indexed. It will be useful as a textbook to the technical student of electric railway engineering and as a reference book to the practising electric railway engineer interested in comparing systems and operations abroad with those in this country. American practice, however, receives a considerable share of illustration and description.

New Apparatus and Appliances

PORTABLE ELECTRIC BREAST DRILL.

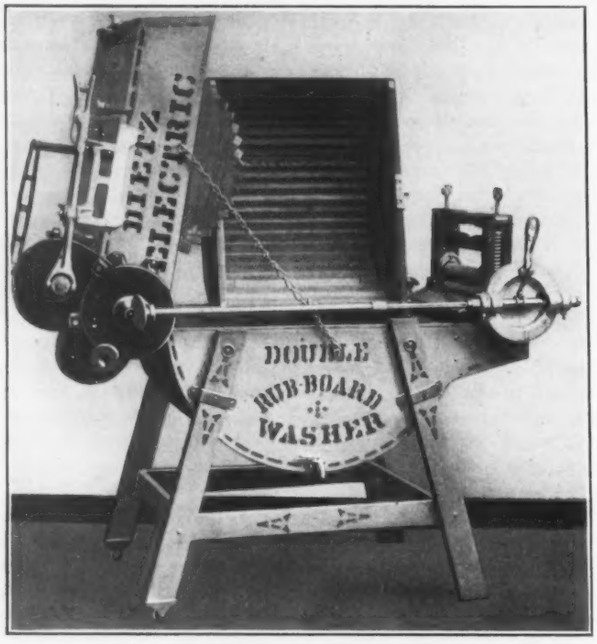
The Western Electric Company has brought out a line of "Hawthorn" portable electric drills which are made for use on 110-volt or 220-volt direct-current and 60-cycle, single-phase, alternating-current circuits, an Edison socket and cord being supplied so the drill can be operated from any standard lamp socket or screw base receptacle. The motor is incased in a dustproof case and all electrical parts are insulated and protected. The frame is of black japan, with nickel-plated trimmings, and an aluminum breast plate or spade handle can be had, as desired. Small oil chambers, so placed as to prevent leakage when the drill is being used, insure good lubrication for all moving parts. The motor, weighing about 20 lb., is supplied with two knurled side handles and the controlling switch is located within reach of the right hand grasping the handle, which allows the operator full control of drill. A Jacob's clutch, which takes drills up to and including 3/8 in. in diameter, and the necessary tightening key are furnished. The tool will be found a handy one for doing a large variety of work, its motor-driven feature saving much laborious effort.



Portable Drill.

A NEW-STYLE ELECTRIC WASHER.

A radical departure in the design of motor-driven washing machines is the feature in a new Dietz electric washer, now being placed on the market. In contrast to the design employed for some time by electric washing-machine manufacturers, it is built on the old double rub-board principle, so favorably known



Dietz Electric Washer.

in the hand-operated form to the American housekeeper; and the designer of the original double rub-board hand-operated machine is also the designer of the new Dietz electric machine.

Power is supplied from a 1/5-hp Westinghouse motor through a rawhide pinion to a gear which drives a bicycle sprocket and chain geared to the crankshaft on the washer. A clutch provides ready means of starting and stopping the washer.

The wringer is mounted on the end of the machine and may be operated with the machine open, when the clothes are wrung out from the tub into the rinsing water, or with the machine closed, when the goods run back from the rinsing water on to the top of the tub. This is made possible by a reversing drive in the wringer, the clutch of which may be operated so quickly that it is possible to back material out before damage results in case it starts incorrectly.

"WESTERN ELECTRIC HAWTHORN" FAN MOTORS.

To the already large list of "Western Electric Hawthorn"

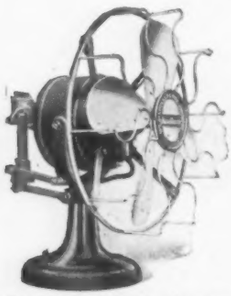


Fig. 1—12-in. Mechanically Operated Oscillating Desk Fan.

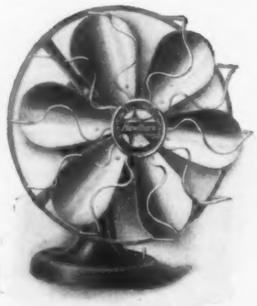


Fig. 2—12-in. Residence-Type Desk and Bracket Fan.

electric fan motors five new types have been added. The most important addition to the line is a new mechanically operated oscillating fan. The oscillating device consists of a double-worm reduction controlled by an oscillating lever. The gears are inclosed in a dust-proof case which is filled with lubricant. Tool steel is used for the worms and phosphor bronze for the worm wheels, thus insuring long life for the mechanism. In this fan the much-desired trunnion feature is retained, thus making a wide adjustment in the vertical plane possible when the fan is used either as a desk or a bracket type. The oscillating motion is very smooth and even, and wholly free from jarring. The range of oscillation is 90 deg. and is adjustable. The success of the 12-in. alternating-current, six-blade resi-

Fig. 3—32-in. Direct-Current Ceiling Fan.

dence fan introduced last year has led the company to place on the market this same style of fan for use on direct-current circuits and also an oscillating fan of the six-blade type. As the increase in the number of blades allows the speed to be cut down without any decrease in the volume of air moved, this fan operates noiselessly, and because of this fact has become very popular. It can be adapted for use either as a wall or bracket type and has two speeds. Another type of direct-current fan has been developed, known as the 32-in. ceiling fan. This fan is attractively designed and is well adapted for use in small offices, houses, hotels, clubs, etc. In exhaust fans the "Hawthorn" fans are being furnished with the well-known Blackman blade, a feature which will be appreciated by all users of small ventilating outfits. The line of "Western Electric Hawthorn" fans now consists of 8-in., 12-in. and 16-in. desk and bracket fans; 12-in. and 16-in. oscillating fans; 8-in. telephone-booth fans; air-operated and mechanically operated oscillating fans and a full line of battery fans, ceiling fans, column fans and exhaust fans for all commercial voltages. These fans are made in various sizes for use on all standard commercial

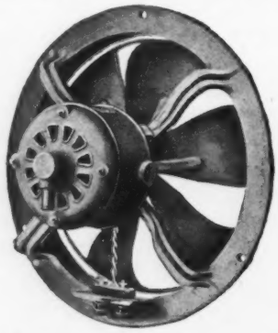


Fig. 4—16-in. Ventilating Fan with Blackman Blades.

Fig. 5—16-in Direct-Current Ventilating Fan.

circuits, both alternating current and direct current, by the Western Electric Company.

PHILADELPHIA ELECTRICAL SHOW.

Philadelphia's second electrical exhibition, given under the auspices of the Electrical Exhibition Company, Ltd., in the First Regiment Armory, Broad and Callowhill Streets, Philadelphia, was opened, as announced in last week's issue, on the evening of Feb. 13. In honor of the event City Hall is fitted with welcoming signs and rows of incandescent lamps skirting the cornices of the building proper; but the statue of Penn, capping the famous tower, is not bathed in the light from searchlamps as was the case in previous shows. Broad Street, from the City Hall to the Armory, is decorated with incandescent arches and signs similar to those employed last year; but the illumination is supplemented this year by arc lamps forming part of the new street-lighting system recently installed in the City of Brotherly Love. These twin arcs are placed on both sides of the street and also on isles of safety in the center of the roadway and together with the arches of incandescent lamps make a pleasing picture when viewed from the exhibition hall with City Hall in the background.

The exhibition hall itself is most tastefully arranged, the decorations surpassing anything heretofore attempted in Philadelphia shows. The whole resembles a sunken garden with vine-covered pergolas enlivened by incandescent electric flowers. The roof is hidden by an azure canopy caught up with metal stars in which incandescent lamps shine every once in a while by thermostatic action. The exhibits, with the exception of that made by the Philadelphia Electric Company, are arranged along the side walls and under the pergolas. The booths are all alike and are partitioned by bronzed pedestals and urns in front and by white columns in the rear. In a majority of cases the urns bear electric flowers. The beams of the pergolas are tipped with 50-watt frosted-bulb tungsten lamps and under the beams are 100-watt tungstens in opalescent reflectors for general booth illumination. The appropriateness of the decoration, with its harmony of color and design, is due to Messrs. Kayser & Allman.

During the two weeks of the show a series of electrically cooked luncheons will be given in order to familiarize visitors with the advantages of electric cooking. Lectures will also be given on electric therapeutics in the lecture hall off the main entrance, and the really valuable electrical medical apparatus will be demonstrated and explained by competent lecturers. No less than six manufacturers of electric vehicles have exhibits of their products arranged along one side of the exhibition hall for ready inspection and comparison. In a show of this kind exhibits are not lacking that appeal to the householder. For example, eight kinds of vacuum cleaners are shown.

The Philadelphia Electric Company's exhibit occupies a space covering the entire east end of the hall, on a raised platform reached by four flights of steps, one at either end and two in the center. A white balustrade, interspaced with bronzed urns containing natural flowers and artificial electric flowers, incloses the platform. At each end of the space is erected a white Grecian temple, the two being connected by five columns which divide the space they cover into natural spaces for exhibits. The temples are outlined by tungsten lamps and are decorated by bay trees and smilax twined around the columns. Each of the latter is surmounted by a large opalescent globe inside of which are colored lamps operated on "skeedoodle" sockets. A large electric sign of tungsten lamps has been placed over the entire exhibit and the sign is also framed in smilax with hanging foliage effect in which hundreds of miniature electric lamps have been hung. In the center of the platform is an electric fountain of fair proportions.

The idea of the exhibit is not to show the extent of the service given by the Philadelphia Electric Company so much as to demonstrate the facilities offered its customers and the methods pursued in the matter of giving good service. To this end one of the temples is used as an illuminating engineering booth and in it is placed a lumichromoscope containing eight compartments, showing eight of the best known electric illuminants in a comparative manner. There is also on exhibition a color cabinet for the purpose of demonstrating the absorptive and reflective values of various colored wall papers, etc. There are also several comparison booths in which the illuminating value of various lamps and reflectors can be shown the public. Frames of photographs, showing installations which have been reconstructed and made efficient by the illuminating engineering department of the company, are displayed.

The temple at the other end of the exhibit is fitted up in an attractive manner as an electric shop and contains practically every known piece of electrical apparatus for use in the home, office, etc. The connecting space in the rear of the columns connecting the temples is occupied by the engineering department. The thought in this exhibit appears to be to show to the public the amount of care taken in maintaining meter accuracy, as well as to give an exposition of the means taken to furnish a reliable service. A meter-testing rack for demonstrating the methods of testing alternating-current and direct-current meters, with the necessary instruments, tools, load boxes and other appliances coincident with this work, is featured. A recording instrument rack, fitted with recording ammeter, voltmeter and wattmeter connected in series with the standard type of house meter and arranged so that a comparison can be made between the energy recorded by the meter and by the instruments, is also shown in this section. Glass showcases containing laboratory standardizing instruments of precision, such as are used for standards in the laboratory and meter department, are included in the exhibit. Among the instruments shown are a potentiometer with shunts and other accessories, portable testing sets, direct-reading ammeters, indicating tachometers, standard cells, Zeiss binocular microscope used for the inspection of jewels and steel bearings, Miller voltmeters and other laboratory apparatus.

The power exhibit contains a three-section panelboard with angle-iron frame on which are mounted a service cut-out box and watt-hour meters as used for standard motor installations. The service is four-wire, two-phase, 220-volt and supplies a 7.5-hp motor driving through shaft and belting a 4-kw, 125-volt direct-current generator. The generator supplies energy to a lamp bank. One panel of the board contains an indicating ammeter and voltmeter and on the other panel are mounted indicating ammeters to show the normal running and starting currents of the alternating-current motor, and a reverse-phase relay with 100-amp circuit-breaker for protecting the service. A motor-testing table in the exhibit is arranged to show the methods of testing motors under service conditions, and wattmeters equipped with high-speed charts are connected to the motor service. An oscillograph is exhibited and shows the wave forms of single-phase and two-phase alternating currents, etc.

At the north end of the exhibit the sign department is located. Model letters of various type signs are shown, also a miniature illuminated billboard. At the south end of the exhibit is a small space fitted up as a lounging place. Advertising literature covering all branches of the business is given to all visitors. A feature of the general arrangement is the use of glass risers on the steps leading to the platform. These risers are illuminated from the rear by electric lamps and painted with the slogans, "If it isn't electric it isn't modern" and "Electricity, everywhere for everything, in Philadelphia."

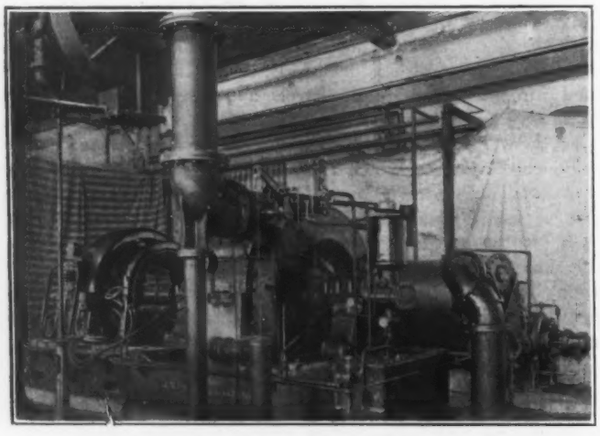
The list of exhibitors is as follows: American Telegraph Typewriter Company, Auxiliary Fire Alarm Company, L. D. Berger, Charles Bond Company, J. F. Buchanan & Company, Judson C. Burns, J. F. Burns, the H. B. Camp Company, Capitol Turbine Company, City of Philadelphia, Columbus Buggy Company, Commercial Truck Company of America, Edison Storage Battery Company, the Electric Storage Battery Company, *Electrical Review* Publishing Company, Electrical Contractors' Association, *Electrical World*, Engineering Equipment Company, Federal Sign System (Electric), Flexlume Sign Company, Fort Wayne Electric Works, Franklin Institute, General Electric Company, General Vehicle Company, Gillinder & Sons, Inc., Gudeman & Company, International Correspondence Schools, Invincible Renovator Sales Company, Keller Manufacturing Company, Keystone Telephone Company of Philadelphia, Ki-

netic Engineering Company, Lewis-Roth Company, Machedo & Roller, the McCrum-Howell Company, National Carbon Company, Otis Elevator Company, H. T. Paiste Company, the Pennsylvania Storage Battery Company, *Popular Electricity* Publishing Company, the Philadelphia Electric Company, Philadelphia Printograph Sales Company, Philadelphia Rapid Transit Company, Philadelphia Storage Battery Company, Rider-Ericsson Engine Company, F. S. Rollins, Simplex Electric Heating Company, Spring Garden Institute, State Optical Company, Straight Filament Lamp Company, University of Pennsylvania, the Waverley Electric Company, Westinghouse Electric & Manufacturing Company, Williamson Company and Woods Electric Garage.

The show closes Feb. 25.

LOW-PRESSURE TURBINE INSTALLATION AT DAVENPORT, IA.

About two years ago the Bettendorf Axle Company, of Davenport, Ia., was considering an addition to its electrical equipment due to the growth of the plant, and made a thorough investigation of the various prime movers suitable for the purpose. Taking into consideration the heating of the shops in winter and the fact that the old power plant was running non-



Lop-Pressure Turbine Driving 250-Volt Direct-Current Generator.

condensing all factors pointed to the low-pressure or exhaust turbine as the most suitable unit to install from the standpoint of reliability, simplicity, economy and maintenance.

The power equipment at that time consisted of two 100-kw direct-connected, high-speed, tandem-compound, engine-driven units, a number of hydraulic pumps and an air compressor exhausting into one header, making an ideal arrangement for connection to an exhaust turbine. Having made a study of various turbine plants, the company decided to install a 500-kw horizontal Curtis turbine. This turbine was put in operation in September, 1909, and has been in service for about fourteen hours a day since. It now supplies all 250-volt energy required by the plant, the load at present amounting to 250 kw on an average, this power being used mostly for the operation of cranes, for the lighting of shops and for lifting magnets. When machinery now under construction is completed and installed the load will be doubled. The main steam supply is derived from the exhaust of the hydraulic pumps, but, owing to the fact that these pumps are subjected to interrupted service due to breakdowns on the system, other means of supplying steam had to be provided and a connection was therefore made from the exhaust header to the high-pressure steam pipe through a Foster pressure-reducing valve. By means of this connection the required amount of steam to keep the turbine in operation is secured. This arrangement works very satisfactorily, as the valve operates within a range of ½ lb. drop in pressure. The average back pressure is about 3 lb., and to take care of an excessive back pressure the exhaust header is provided with a 12-in. relief valve set to operate at 5 lb. pressure. All steam to the turbine passes through an 18-in., two-stage separator, which separates all oil and moisture from the steam. A Worthington condenser is installed, the condensed steam being returned to the boiler feed-water heater.

While no figures are available to substantiate a statement as to the exact performance of the turbine, it is thought possible, when running with 28-in. vacuum, to recover 75 per cent of the energy delivered to the pumps, compressors and reciprocating engines. In cool weather it has been possible to run for weeks with a vacuum of from 29 in. to 29½ in., this, of course, making quite a difference in the steam consumption. In order to maintain a good vacuum it has been found necessary to pipe the steam seal, in which the carbon packing rings are located, with high-pressure steam to insure against any leakage of air around the shaft. The amount of steam required for this purpose can best be found by experiment and when once adjusted requires very little attention.

Before putting the turbine in service it was run for a few days under various loads, the generator being loaded from a water rheostat. It was found that sufficient exhaust steam was available to furnish 425 kw continuously and as much as 575 kw for short periods. Six boilers of about 120 hp each were in service at that time. The results of the test would indicate that from 75 per cent to 80 per cent of the energy delivered to the engines and auxiliaries was recovered.

The governing of the turbine is very good, as with a load fluctuation of about 500 amp the variation in potential does not exceed 2 volts or 3 volts. The lighting load consists of inclosed-arc, flame-arc, mercury-vapor and incandescent lamps, all of which show up very much better when operated by the turbine than when the engine-driven units carry the load. This improved performance is owing to the better regulation of the turbine.

In operating the turbine a practice is made of drawing a few buckets of oil from the tank every two weeks and adding the same amount of fresh oil. This seems to keep the oil in good condition. No trouble has been experienced in keeping the bearings cool, this being accomplished by means of circulating water. In order to maintain a uniform flow the water is taken direct from the mains and passed through a reducing valve which takes care of any fluctuation in pressure in the main supply. The emergency governor is tested regularly once a week. It has never failed to respond to increase in speed, invariably tripping the stop valve on the turbine. It is found that the attention required by a turbine generator of the size here installed is not as much as that demanded by one of the engine-driven units. Good results are obtained without the use of a receiver between the units and the turbine, as the reducing valve makes up for any deficiency in the steam supply which might be due, as stated before, to the stoppage of one of the engines or pumps. With this arrangement a sufficient supply of steam (direct from the boilers if necessary) is always assured, thus making the installation fully as reliable as the high-pressure engine or turbine and much more economical than either of these when running non-condensing. The longest continuous run so far made with this turbine has been five days and nights. No shut-downs due to trouble of any kind with the turbine have occurred since the turbine was first put in operation.

REGENERATIVE CONTROL FOR ELECTRIC VEHICLES.

For years an occasional suggestion has been made relating to a control system whereby an electric vehicle in going down a hill should turn the motor into a generator and thereby return to the battery a very considerable amount of extra energy required to climb the hill. The Lansden Company, of Newark, N. J., has actually used such a system for a period of two years, having covered a distance of over 19,000 miles with an

experimental model, and recently it has been applied to a 5-ton truck for Mr. George Ehret, the brewer.

A system of this kind shows on the level, of course, no increase in mileage over the ordinary series type of motor, but where grades in excess of a few per cent are encountered a very considerable gain is effected, 35 per cent often being returned to the battery on the down grade. Another result of this simple method of control is that the truck becomes practically a constant-speed machine, climbing ordinary hills at practically the same speed as on the level and held back on the descents, not by brakes, but by the force required to generate the energy returned to the battery. This eliminates all the wear and tear due to brakage and implies a motor wagon of the greatest efficiency and cheapest repairs.

The details of design have been completely worked out, both motor and controller being designed especially for the Edison battery. The controller actually handles a very small quantity of current, only a fraction of that driving the machine, meaning much less wear and tear, less attention and adjustment and a greater assurance of safety.

The Lansden Company has gone a step further in designing this 5-ton truck and by making radical departures has still further increased the truck's efficiency by using a helical spring suspension with flat leaf springs as distance or reach-rods. This cushions the strains of starting, of road obstructions, or of stopping, with the result that a big 5-ton truck rides and is handled as easily and smoothly as an ambulance.

GENERAL ELECTRIC FANS.

The General Electric Company's fan-motor models for 1911 represent a complete line designed for satisfying the requirements of a wide field of application. Several improvements are noticeable, one being the adoption of a new induction winding for the 8-in., 12-in. and 16-in. alternating-current fans, which obviates the use of a centrifugal switch for controlling the starting winding, thus eliminating all noisy contacts and insuring quiet operation with low energy consumption and great speed range. The entire line includes both alternating-current and direct-current, 8-in., four-blade desk, bracket, oscillating and telephone-booth fans; 12-in., six-blade residence bracket and oscillating fans; 12-in. and 16-in. standard desk and bracket fans; 12-in. and 16-in. oscillating fans for either desk or bracket use; together with a great variety of ceiling counter-column and floor-column motors of attractive plain and ornamental design. The desk, bracket and oscillating fans in general are convertible for either desk or bracket use and vice versa, by means of a hinged joint, attaching the motor body to the base, which permits of a simple and quick vertical adjustment. The telephone-booth fans are suspended from brackets by means of a spring suspension, thus preventing vibration from being transmitted to the walls of the booth. The six-blade fans operate very quietly and are designed especially for use in residences, hospitals and other places where such operation is desirable. The motors are equipped with suitable switches for giving three speeds, the maximum ranging from 1250 r.p.m. to 1600 r.p.m., thus providing a regulation sufficient for all requirements. The alternating-current motors carried in stock are for circuits of 25 cycles at 110 volts; 40 cycles at 120 volts; 50 cycles at 100 volts, 110 volts, 200 volts and 220 volts; 60 cycles at 110 volts and 220 volts, and 133 cycles at 110 volts. The direct-current motors are for 110-volt and 220-volt circuits. The alternating-current ceiling and column fan motors are designed for operation on 25-cycle, 40-cycle, 50-cycle and 60-cycle circuits. The plain types have two speeds, ranging from 150 r.p.m. to 225 r.p.m. The direct-current motors are designed for 110-volt and 220-volt circuits. The plain types operate at 200 r.p.m. The ornamental single-speed types operate at 200 r.p.m. and the three-speed types at 100 r.p.m., 150 r.p.m. and 200 r.p.m. Both the alternating-current and the direct-current fans are of the four-blade type; the former have a sweep 52 in. and the latter 58 in. They are wired for electrolier attachments of two or four lamps.

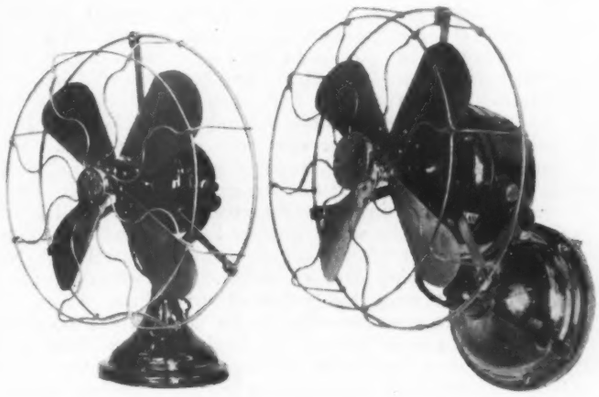


Fig. 2—12-in. and 16-in. Alternating-Current Desk Fan.

Fig. 3—12-in. and 16-in. Alternating-Current Bracket Fan.

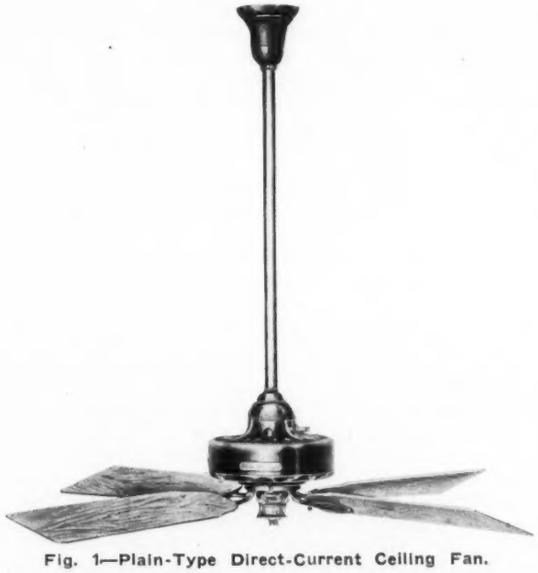


Fig. 1—Plain-Type Direct-Current Ceiling Fan.

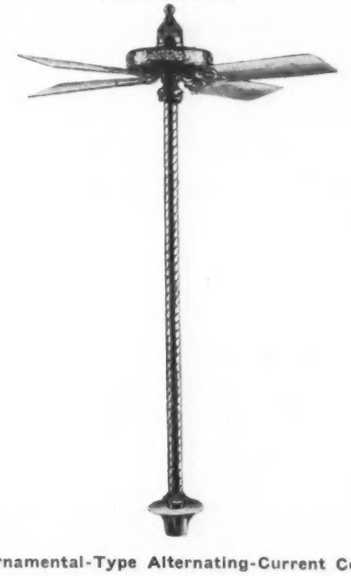


Fig. 4—Ornamental-Type Alternating-Current Column Fan.

Industrial and Commercial News

The Week in Trade.

COMMERCIAL conditions during the past week looked a trifle brighter. There are several reasons for this. In the first place, timely and badly needed rainfalls have brought the prolonged drought to an end, and crop conditions in the West and Southwest have been materially improved thereby. Another reason for improvement is in the fact that the demand for finished steel has increased so that quite a number of mills which have been running part time are now actively in operation. This demand has added to the buying capacity of the industrial sections and has stimulated to some extent retail trade. There are still many complaints, however, concerning the retail distribution. The unusually warm weather has practically destroyed the usual winter trade in heavy wearing apparel and has caused some carrying over of stocks. The wholesale trade during the past week has improved very little. From the Southwest there was somewhat better demand, but no other section shows any addition to its buying ability. The most discouraging branch of trade at the present time is the textile industry. Neither in cotton nor in woolen materials is there any feature that promises well for the future. The prices of raw material have been irregular and have disturbed commercial conditions, and the demand for finished products has been lighter than for many years. Curtailment has been going on and will probably be continued, and prices are being shaded in order to make sales. Such lines as farm machinery, implements, seeds and fertilizers are very active, but this is nothing more than was expected at this season. The railroads are ordering but little equipment, and are merely filling in. As a rule the reports of traffic are not particularly encouraging, and net earnings are showing very much less gains than gross earnings, owing to increased expenses. Collections on the whole are rather slow, although from some of the agricultural sections payments are reported as prompt. Business failures for the week ended Feb. 16, as reported by *Bradstreet's*, were 235 as against 291 the previous week, 269 in the same week in 1910, 282 in 1909, 326 in 1908 and 177 in 1907.

The Copper Market.

DEVELOPMENTS in the copper market last week were of minor importance. The takings, both by domestic consumers and for export, were very light. Of course, the market is still in the hands of the great financial interests which have for years sustained the price of the metal in order to protect the prices of stocks. There is not much likelihood, therefore, that there will be any serious break in the price of copper. When consumers can buy electrolytic copper in the neighborhood of 12 cents they had better be content to take in all the stocks they require. It is not at all probable that the enormously wealthy holders of Amalgamated and other copper stocks will permit prices to be shaded much below this figure. It is stated that during the past week manufacturers of finished copper and brass have contracted for moderate amounts to be delivered in March and April. The buying, however, is, as a rule, from hand to mouth and to cover orders already in sight. With little pressure to sell and little anxiety to buy, the market remains very quiet. Electrolytic closed last week at about the same figure as the week previous, but standard was quoted a trifle higher. Exports continue to be rather light. For the month, including Feb. 18, they were 10,060 tons. The daily call on the Metal Exchange Feb. 17 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.10	12.20	.....
February	12.10	12.20	12.15
March	12.10	12.20	12.15
April	12.10	12.20	12.15
May	12.10	12.20	12.15

The London market, Feb. 17, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	55 0 0	54 16 3
Stand copper, futures	55 12 6	55 8 9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard *	12.30c	11.87½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 10 0

*Last price quoted.
Shares sold for week Feb. 13 to Feb. 18.

Industrial and Commercial Notes

Western Electric's January Earnings.—January was the first month of the Western Electric Company's new fiscal year, which will correspond with the calendar year hereafter. Earnings were slightly in excess of January, 1910, which is a very satisfactory showing in the face of the fact that some of the large electric manufacturing companies showed a decrease as compared with the previous January, and considering that in December, that being the last month of the old fiscal year, every effort was made to "clean up" orders on hand, so that the carry-over would be as small as possible. The larger January showing comes from within and without this country, and the increase was very evenly distributed. Western Electric's gross business for the twelve months ended with last November totaled $61,000,000, and for the thirteen months ended with December approximately $68,000,000. The company is in a strong position in regard to financial resources, and will be able to continue its policy of concentration at Hawthorne this year, without incurring further funded obligations.

Doherty Suit in Montgomery.—Henry L. Doherty & Company last week brought another suit in the United States Court in Montgomery, Ala., against the Citizens' Light, Heat & Power Company and Richard Tillis. It will be remembered that the Doherty company has been in litigation with the Citizens' Light, Heat & Power Company for a year over an alleged contract of sale made by Alex Rice, president of the company, to Doherty. Two weeks ago the United States Court of Appeals decided in Mr. Doherty's favor a motion to prevent Richard Tillis, who is now the owner of the Citizens' company, from extending his lines. The new suit which was brought last week asks for a permanent injunction preventing Mr. Tillis or the Citizens' company from extending the business of that organization.

Rio de Janeiro Tramway Equipment.—The Rio de Janeiro Tramway, Light & Power Company, Rio de Janeiro, South America, has placed an order with the Westinghouse Electric & Manufacturing Company for two 2500-kva, 3000-r.p.m., 6300-volt, three-phase, 50-cycle turbo-generators. The Westinghouse Machine Company will furnish the turbines, which will be equipped with No. 11 Leblanc condensers. This equipment will be placed in a new station, which will operate in connection with the power company's water-power station. The station will be located in the city and will be used only when the water is low and the water-power plant cannot deliver its full capacity.

Westinghouse Electric & Manufacturing Company.—The Cia Beneficiandora de Pachuca de Mexico has recently bought one 915-kva O. I. S. C. auto-tranformer from the Westinghouse Electric & Manufacturing Company. The 3-phase, 10,000-volt high-tension, 6600-volt low-tension transformer is designed to operate on either 50 cycles or 60 cycles, and will connect together two systems, one of 10,000 volts and the other of 6600 volts, in case of failure of either system. The transformer will be able to switch the 1000-hp load of a compressor motor from one circuit to the other in case of failure of the circuit that is operating.

Consolidated Gas Company.—The Consolidated Gas Company of New York has definitely determined to make no further contest against the 80-cent gas law. The actions which were brought by the company to have this law declared unconstitutional, and which were still pending in the United States Circuit Court, were formally discontinued last week upon motion of the company. This practically means that there will be no further litigation over the law or over the rate for gas. It has been shown to the satisfaction of the company that at the 80-cent rate a reasonable dividend can be paid.

Insulated Wire Wanted.—The General Purchasing Officer of the Isthmian Canal Commission, Washington, D. C., invites sealed proposals in triplicate for furnishing to the commission 6000 ft. of No. 6 stranded rubber-covered, weatherproof wire. Bids will be opened not later than 2:30 p. m., March 6, 1911.

Insulated Wire.—The demand for insulated wire is not at all satisfactory. The president of one of the largest manufacturing companies in the country says that the opening up of spring business has brought very few additional orders for insulated wire. In some localities large building operations are planned upon an extensive scale, but as a rule it does not appear that building during the year will be up to the average. As this wire manufacturer says, the wire contracts are usually the last let in connection with a new building, and for this reason the wire manufacturers never can tell exactly what they have in the way of new business until midsummer. He says: "The insulated wire business has been seriously interfered with by price cutting and by the placing upon the market of materials which we think are inferior to those made by the old-line companies. This kind of business has demoralized the regular trade. The companies are at present, however, enjoying a period of fairly cheap raw material. Rubber is not excessively high and other materials are much cheaper than they were eighteen months ago. The margin of profit is therefore more satisfactory."

Important Telephone Conferences.—Several important conferences were held in New York last week between Independent and Bell telephone interests located in the West with a view of arriving at some definite operating arrangement that would result in the mutual advantage of both sides. Among those attending the conference were H. P. Davison, representing the Morgan interests; Mr. Kingsbury, representing the American Telephone & Telegraph Company, and several prominent financiers from Columbus, Ohio, Indianapolis and St. Louis representing independent properties. No official statement was given out concerning the results achieved at the meetings, but one of the Western men said: "It will be some time yet before this matter can be consummated. There are many obstacles to be overcome which will require a great deal of time and consideration. I can say, however, that nothing will be accepted which is not beneficial to the independent interests."

Electrical Jobbers' Meeting.—The Electrical Jobbers' Association met in convention at French Lick Springs, Ind., Feb. 15, 16 and 17, and about 300 electrical supply men and guests were in attendance. As in the case of most of the former gatherings of this association, no technical papers were read, but many discussions were carried on relating to the welfare and promotion of the jobbing business. Among those who addressed the meeting was W. H. Merrill, of the Underwriters' Laboratories of Chicago, who gave an informal talk on standardization of appliances and material. The next meeting will be held April 25, 26 and 27 at Del Monte, Cal., and a special train is being arranged for to leave Chicago April 18.

New York Edison Company.—The New York Edison Company on May 1 will move its Delancey Street offices in New York City to a new building across the street from its present location. This change has been made necessary by the rapid growth in the company's business in that section. In 1910 the Delancey Street department of the company made a 30 per cent net gain in the number of customers and approximately a 35 per cent net gain in 50-watt equivalent power supply. This station serves the garment shops and crowded tenements of the East Side, and these, it is said, are putting in electric service wherever it is possible.

Japan Ordering Apparatus.—The Westinghouse Electric & Manufacturing Company has just received an order for one 200-kva rotary converter, two 125-kva O. I. S. C. transformers and one three-panel switchboard, for shipment to the Nikkon Gas & Electric Company, Nikkon, Japan. The rotary will be used on street railway service. It is designed for operation at 365 volts, two-phase, 60 cycles alternating current and 550 volts direct current.

Moloney Electric Company.—The Moloney Electric Company, of St. Louis, manufacturer of transformers, is equipping a large manufacturing plant in Windsor, Ont., to take care of its Canadian business. The Chicago office of this company, in charge of Mr. R. T. Merrick, has been removed to 1406 Fisher Building, from the Railway Exchange.

Chicago to Have a Commercial Representative in South America.—The Chicago Association of Commerce has made an arrangement with Frank C. Enright to represent the 3000 or 4000 commercial houses which constitute its membership in South America, making his headquarters at Buenos Aires. Mr. Enright is to promote the trade of members of the association in South America in every way possible, and he is to give his exclusive services to the association at a fixed salary. Mr. Enright was born in Buenos Aires, of Irish parentage, about thirty-five years ago. He will sail from New York for that city on April 20.

Financial.

THE WEEK IN WALL STREET.

THE volume of trading in the Wall Street market was considerably reduced last week and prices receded several points for most of the active issues. The market is practically in the same condition as at the last report. After the January advance a pause has taken place in the upward movement, and this is due in the first place to the fact that the steam behind the movement was not particularly strong and the professional speculators who were in charge of the manipulation were inclined to be timid. It is generally believed in Wall Street that the decisions in the Standard Oil and Tobacco cases will be handed down in a very short time. These decisions involve the very life of our great industrial corporations. If it is held that the practices employed by the Standard Oil and American Tobacco Companies are in violation of the law, hundreds of our largest industrial enterprises will be compelled to amend their business methods. As far as regards actual developments last week, there was little of importance except the elimination of the Gould party from Missouri Pacific. This has been hinted at in financial circles for a good many months. Missouri Pacific has never enjoyed that measure of success which its position seemed to deserve and which came to its rivals in the Central West. It is believed that with the introduction of a new management and with stronger financial backing the property will soon be revolutionized. The money market continues to be easy and there is apparently enough cash for all the business that is being transacted. The rates Feb. 20 were: Call, 2¼ @ 2½ per cent; 90 days, 3¼ per cent. The quotations in the table are those of the close Feb. 18.

NEW YORK.

	Feb. 11.	Feb. 18.	Shares Sold.		Feb. 11.	Feb. 18.	Shares Sold.
All. Ch.....	8*	7⅞*	400	Int. Met.,pfd.	55	54	9,250
All. Ch., pfd.	32½*	32*	400	Mackay Cos..	94*	92½	100
Amal. Cop..	66	65¼	46,940	Mackay C.,pf.	76½*	76	500
Am. D. T...	20½*	20½*	———	Man. Elev..	139¾*	139¾*	460
Am. Loco....	41½*	41¼	3,200	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	110*	110*	———	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	84½*	84½*	———	Steel, com...	81½	80⅞	434,230
Am. T. & T.	145	146¼	11,450	Steel, pfd...	119	119⅜	5,605
B. R. T....	78⅝	78½	18,575	W. U. T....	74¾*	74½	1,700
Gen. Elec....	155½	153½*	900	West'h, com.	70*	70	2,500
Int. Met.....	20¼	19⅞	6,465	West'h, pfd..	119*	119*	———

PHILADELPHIA.

	Feb. 11.	Feb. 18.		Feb. 11.	Feb. 18.
Am. Rys.....	44½*	45	Phila. Elec.....	16⅜	16½
Elec. Co. of A.....	12⅛*	12⅛*	Phila. R. T.....	20¼	19¾
Elec. St. B'ty.....	54	55	Phila. Trac.....	85¾	85*
E. S. B'ty., pfd.....	30*	30*	Union Trac.....	47¾	47

CHICAGO.

	Feb. 11.	Feb. 18.		Feb. 11.	Feb. 18.
Chi. City Ry.....	185	185*	Chi. Tel. Co.....	122½	121
Chi. Rs., Ser. 1.....	93*	93*	Met. El. Co.....	20*	20¼
Chi. Rs., Ser. 2.....	25	24½*	Met. El., pfd.....	65½*	65½*
Com. Edison.....	115	116*	Nat'l Car.....	117*	117*
Chi. Subways.....	4*	4*	Nat'l Car., pfd.....	118*	118*

BOSTON.

	Feb. 11.	Feb. 18.		Feb. 11.	Feb. 18.
Am. T. & T.....	145½	146¼	Mex. Tel.....	4¾*	4¾*
Cum. Tel.....	148*	149*	Mex. Tel., pfd.....	7*	6*
Edison E., Ill.....	291*	290¼	N. E. Tel.....	142*	142
Gen. Elec.....	155¼	153½*	W. T. & T.....	20	20½
Mass. E. Ry.....	17½*	17¼	W. T. & T., pfd....	96*	95
Mass. E. Ry., pfd...	88	87½*			

FINANCIAL NOTES

Mackay Companies.—The annual meeting of the Mackay Companies was held in Boston last week, and the present board of trustees was re-elected. The profit and loss accounts of the companies for the fiscal year which ended Feb. 1 show receipts of $4,125,907, and disbursements, including $2,000,000 for preferred dividends, of $2,069,020. Clarence H. Mackay, president of the companies, said in his report: "The past year has been one of healthy expansion in business, and our companies are in excellent physical and financial condition. During the year we completed a 830-mile trunk telegraph line between Oakland, Cal., and Salt Lake City. This new line was constructed of the most modern type copper cable, running 20 lb. between poles.

In addition, we have put in sixty lines of the same type between several Pacific Coast cities. The money received about a year ago from the sale of our holdings of American Telegraph common stock has been reinvested in high-grade securities. During the year we have completed a new cable between Waterville, Ireland, and western England, with underground connection to London." The report also states that the night-letter system, which was inaugurated during the year, has brought in a considerable amount of business, but the managers of the company are not yet ready to declare that it is entirely successful.

Kings County Electric Light & Power Company.—The annual report for 1910 of the Kings County Electric Light & Power Company, which owns all of the stock of the Edison Electric Illuminating Company of Brooklyn, was made public last week. It showed that the gross earnings of the company for the year were $4,338,987, as compared with $3,733,840 the previous year. After the payment of all expenses and charges there was left a surplus for the year's business of $1,009,233, which is equivalent to a little more than 10 per cent on the outstanding capital stock. Anthony N. Brady, president of the company, says in his annual report: "The number of customers Dec. 31, 1910, was 23,866, an increase of 4028 over the preceding year, and total connections in 50-watt equivalents were 2,036,473, an increase of 264,116. During 1910 14,192 contracts were signed, against 12,494 in 1909; power in horse-power was contracted for to the extent of 17,731, against 11,506 in the preceding year, and total lighting and power in 50-watt equivalents was contracted for up to 813,992, against 561,605 in 1909."

Studebaker Merger Plan.—There has been incorporated under the laws of New Jersey the Studebaker Corporation with an authorized capital stock of $45,000,000. The company was formed, as it was stated by its incorporators, to purchase the assets and property of the Studebaker Manufacturing Company, of South Bend, Ind. This concern, it is announced, is devoted to the manufacture of carriages, wagons and automobiles and owns and operates the E. M. F. automobile concern of Detroit. The Studebaker Corporation will manufacture electric vehicles as well as gasoline and will also continue the original Studebaker business, which was the making of horse-drawn vehicles. In addition to the above lines of industry the Studebaker company has acquired the right to manufacture several brands of popular gasoline motor cars. The purchase involves the acquisition of $7,447,253 in cash and the property taken over was paid for in the stock of the new corporation to the amount of $43,498,000, of which $13,500,000 is 7 per cent cumulative preferred.

Light & Development Company.—The Light & Development Company, of St. Louis, which was organized last year and applied for a franchise from the city to operate a light and power plant in competition with the Union Electric Light & Power Company, has made a report concerning its present activities. The company is now operating in St. Louis isolated plants in the Famous, the Leader and Buckingham buildings, furnishing light, power and heating at each installation. It is also operating outside of St. Louis the Cape Girardeau (Mo.) Water-Works & Electric Light Company, stock $150,000, bonds $150,000; the Paris (Tex.) Light & Power Company, stock $200,000, bonds $200,000; the Fort Scott (Kan.) Gas & Electric Company, stock $350,000, bonds $350,000, and the Talequah (Okla.) Light & Power Company, stock $40,000. H. Wurdach is president of the Light & Development Company; W. A. Smith, vice-president, and H. W. Beck, secretary.

Electric Security Offerings.—Among the important offerings last week of electrical securities were: By Harris, Forbes & Company, New York, $4,044,000 5 per cent, first-lien and refunding bonds of the Consumers' Power Company, of Michigan, at 96 and interest, and by P. W. Brooks & Company, New York, $700,000 first mortgage, 5 per cent bonds of the Kankakee (Ill.) Gas & Electric Company at a rate to net about 5.40 per cent. The Consumers' Power Company is the operating company of the public utility properties in Michigan which were formerly owned by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia. All of the stock of the Consumers' Power Company is held by the Commonwealth Power, Railway & Light Company, an $18,000,000 holding concern organized by the same interests under the laws of Maine.

Federal Sign System (Electric).—Brokers in Chicago and New York announce the sale of a limited amount of 7 per cent cumulative preferred stock of the Federal Sign System (Electric), Chicago, of which John H. Goehst is president and John F. Gilchrist is treasurer. The stock is offered at par and accrued interest with a bonus of 40 per cent of the common stock voting-trust certificates. The majority of the common stock is held in a voting trust, with Samuel Insull, Mr. Goehst and Mr. Gilchrist as voting trustees. The company is engaged in selling, renting and operating electric signs and in the sale of electricity-consuming devices and supplies in nineteen cities, including Chicago, New York, St. Louis, Cincinnati, Philadelphia, Baltimore, Pittsburgh, New Orleans, Buffalo and Kansas City. It is closely related to the Federal Electric Company, which does a manufacturing business.

National Carbon Company Stock.—At a meeting last week of the governing committee of the Chicago Stock Exchange $4,500,000 preferred stock and $5,500,000 common stock of the National Carbon Company were admitted to the regular trading list. This action was in the nature of a readmission, the stocks having been excluded last December on account of the action of the directors in declaring a dividend without any previous notification to the stockholders. This dividend, which was $15 per share, was declared without any warning at all to the governing committee of the exchange.

Cumberland Telephone & Telegraph Company.—The twenty-eighth annual report of the Cumberland Telephone & Telegraph Company, which was for the year 1910, shows that the gross earnings from all sources amounted to $6,897,080, which was an increase over the previous year of $281,712. Operating expenses were $3,894,409, a very small increase over the previous year. The net earnings of the company increased $266,742. After deducting interest and dividends the company carried over at the end of the year a surplus of $832,856.

Montreal Light, Heat & Power Company.—On Feb. 10, a number of important actions brought against the Montreal Light, Heat & Power Company by the City of Montreal for assessment against the following companies, controlled by the power company, were settled by mutual agreement between the attorneys for the various parties: Montreal Gas Company, $64,805; Royal Electric Company, $42,576; Imperial Electric Company, $3,718; Lachine Rapids T. & L. Company, $10,629; total, $121,727.

Consolidated Gas, Electric Light & Power Company.—From a communication just sent out from the Consolidated Gas, Electric Light & Power Company, of Baltimore, it is learned that the company proposes to increase its common stock to the extent of $2,199,966, instead of $1,500,000, as was given out in connection with the company's new financing plan. The present authorized common stock issue is $6,300,034, and it is the plan of the company to increase it to $8,500,000.

American District Telegraph Company.—Theodore N. Vail, president of the American Telephone & Telegraph Company, was last week elected president of the American District Telegraph Company, of New Jersey, succeeding Robert C. Clowry, formerly president of the Western Union Telegraph Company. This is simply a change in organization, which is in line with the introduction of the telephone interests in the Western Union Telegraph Company.

DIVIDENDS.

American Gas Company, quarterly, 1¾ per cent, payable March 1.

American Railways Company, quarterly, 1½ per cent, payable March 15.

Blackstone Valley Gas & Electric Company, preferred, quarterly, 1½ per cent, payable March 1.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable April 1.

Detroit Edison Company, quarterly, 1¾ per cent, payable April 15.

Federal Mining & Smelting Company, preferred, quarterly, 1¾ per cent, payable March 15.

Galveston-Houston Electric Company, semi-annual, preferred, 3 per cent; common, 1½ per cent, both payable March 15.

International Smelting & Refining Company, quarterly, 2 per cent, payable March 1.

Manhattan Elevated Railway Company, quarterly, 1¾ per cent, payable April 1.

Northern Ohio Traction & Light Company, quarterly, ¾ per cent, payable March 15.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, quarterly, ½ of 1 per cent, payable March 1.

West Penn Traction Company, semi-annual, 1 per cent, payable March 15.

General News

Construction News.

CALERA, ALA.—The local electric light plant, owned by Mrs. Stein, of Calera, has been purchased by Everett Crim, who will take possession at once.

EUFAULA, ALA.—The City Council is reported to have engaged an engineer to prepare plans and estimates of cost of constructing a municipal electric-light plant for Eufaula.

SEWARD, ALASKA.—The Alaska Telephone Company, recently organized, proposes to erect a telephone line from Seward into the Iditarod, 500 miles in length. Branch lines will be extended to all mining camps in this territory.

PHŒNIX, ARIZ.—Sealed proposals will be received at the office of the Salt River Valley Water Users' Association, Phœnix, Ariz., until March 14 for furnishing, complete, electrical apparatus for use in a plant to be built at the junction of the South and Consolidated Canals on the Salt River project, Arizona. Bids will also be received at the same time and place for supplying two hydraulic turbines with accessories. Further information may be obtained on application to the office of the Salt River Valley Water Users' Association, Phœnix, Ariz., or the office of the United States Reclamation Service, Phœnix, Ariz. Charels A. Van Der Veer is secretary of the association.

CHICO, CAL.—It is reported that local capitalists, who purchased the Spiegle ranch, located on Deer Creek, are contemplating the establishment of an electric generating plant. The purchase includes rights to 500 in. of water in Deer Creek. T. N. Nash is reported to be interested in the project.

LOS ANGELES, CAL.—Sealed proposals will be received at the office of the United States Reclamation Service, Federal Building, Los Angeles, Cal., until March 10, for furnishing turbine water wheels for the Salt River project, Arizona. For further information address the above office or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

MARYSVILLE, CAL.—Investigations are being made by the Great Western Power Company with a view of extending its transmission lines to Marysville if sufficient business can be secured. Other towns and cities in the valley have been visited with the same object in view.

NEVADA CITY, CAL.—Arrangements are being made by the Bay Counties Power Company to establish wireless communication between the different power plants owned by the company and among the mines and water-power stations in the county. George Scarfe is local manager.

NEWPORT, CAL.—The City Council has passed a resolution providing for the construction of a municipal electric-light plant in Newport. Bonds to the amount of $55,000 will be issued to cover cost of same. L. S. Wilkinson is city clerk.

OAKLAND, CAL.—The City Council has granted the Oakland Traction Company a franchise to construct and operate an electric street railway in Hopkins Street from Fruitvale Avenue to Redwood Road in the annexed district for a period of thirty-five years, in return for which the company is to light the street its entire length and to pay the city 2 per cent of its gross receipts.

PETALUMA, CAL.—The City Council has granted a franchise to the Petaluma & Santa Rosa Electric Railroad Company to operate an electric railway through the city. The company proposes to build a railway to Point Pedro and connect with San Francisco by fast ferries.

SAN FRANCISCO, CAL.—The Pacific Terminal Company, recently incorporated with a capital stock of $5,000,000, is a subsidiary of the United Properties Company. The articles of incorporation give the company the right to acquire real estate for water and rail terminals, to construct railroads, operate steamships and to charter power plants. Among the directors are: F. M. Smith, of Oakland, Cal.; W. S. Tevis, of Bakersfield, Cal.; R. G. Hanford and Gavin McNab, of San Francisco, Cal.

TUSTIN, CAL.—The citizens have voted to form a lighting district in Tustin.

DENVER, COL.—Plans are being prepared by the Denver Gas & Electric Company for extensions and improvements to its systems this year, involving an expenditure of about $400,000, and will include the installation of boulevard lighting systems and extensions of gas mains. It is expected to erect ornamental lamp standards on the Speer, Montclair and other boulevards during the year. This work will be under contracts with the city and in conformity with designs made by Henry Read, head of the art commission. William J. Barker is vice-president and general superintendent.

NEW LONDON, CONN.—Sealed proposals will be received at the office of the Constructing Quartermaster, New London, Conn., until March 7 for construction of brick hospital building and installing plumbing, hot water heating, electric wiring and fixtures at Fort H. G. Wright, N. Y. A deposit of $10 will be required for plans. Captain F. T. Arnold is constructing quartermaster.

NORWALK, CONN.—A bill has been presented to the State Legislature by Representative Henry Matheis asking permission for the City of Norwalk to purchase electricity from the municipal electric plant at South Norwalk for street lighting; under the present law this cannot be done. The Housatonic Light & Power Company now supplies the service. Another bill has also been presented for consolidation of the two cities.

WASHINGTON, D. C.—Proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 6 for furnishing an electric type freight lift, hoistway, etc., for the United States custom house and post office building at Brunswick, Ga. Plans and specifications may be obtained at the above office. James Knox Taylor is Supervising Architect.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 10 for furnishing and installing lighting fixtures in the United States buildings at Ashtabula, Ohio; Brainerd, Minn.; Centralia, Ill.; Dayton, Ohio; Lexington, Ky.; Lima, Ohio; Lincoln, Ill., and Detroit, Mich. Plans and specifications may be obtained at the above office. James Knox Taylor is Supervising Architect.

ATLANTA, GA.—The installation of a new lighting system in Grant Park is under consideration. It is proposed to install incandescent lamps on ornamental lamp standards.

MONTICELLO, GA.—The Jasper Cotton Mills has changed its name to the Castle Cotton Mills and the capital stock of the company has been increased from $200,000 to $1,000,000. The company proposes to build a plant to be equipped with 50,000 spinning spindles, 5000 twister spindles and 1200 looms, to be operated by electricity, which will be furnished by the transmission line of the Central Georgia Power Company, of Macon, Ga. About 5000 hp will be required. William T. Lang, of West Point, Ga., is president of the new company. It is understood that work will soon begin on construction of the plant.

POCATELLO, IDAHO.—It is reported that the substation and transformer house of the Idaho Consolidated Power Company in Pocatello was destroyed by the flood waters of the Portneuf River.

BLUE MOUND, ILL.—Frank L. Suffern is reported to have purchased the local electric light plant formerly owned by Luther C. Nichols.

PARIS, ILL.—The City Council has granted the Central Illinois Public Service Company, of Mattoon, Ill., a fifty-year franchise in this city for the proposed extension of its interurban railway to Charleston.

PEORIA, ILL.—Plans are being prepared by the Illinois Traction System for the construction of an extension of its system from Beatrice to Adams, a distance of thirty miles. In order to secure the extension capital stock to the amount of $300,000 must be subscribed by Gage County.

RIDGEFARM, ILL.—The Georgetown Electric Company, of Georgetown, is reported to have purchased the local electric light plant.

SANDOVAL, ILL.—The installation of a municipal electric light plant in Sandoval is reported to be under consideration. Joseph Thomas is Mayor: R. R. McCall and W. J. McNally are members of the committee.

SHELBYVILLE, ILL.—The Queen City & Shelby County Mutual Telephone Company has voted to purchase the property of the Shelby County Telephone Company and independent lines heretofore operated by E. M. Harwood for $14,425.

TOLONO, ILL.—The local electric light plant is reported to have been taken over by the Chase Engine & Manufacturing Company. It is understood that the new owners will erect transmission lines to Sadorus, Pesotum and Philo.

CHESTERTON, IND.—The Northern Indiana Gas & Electric Company has recently ordered two 3850-kva steam turbines from the Westinghouse Machine Company, of Pittsburgh, Pa. The turbines will be connected to a 750-kva, 13,200-volt, 3-phase, 60-cycle Westinghouse generator and will operate on a steam pressure of 75 lb. and will exhaust into a vacuum of 28 in.

CYNTHIANA, IND.—Bonds to the amount of $4,000 have been issued by the Town Board to secure funds to install an electric light plant in Cynthiana.

FORT WAYNE, IND.—The Board of Public Works, the Board of County Commissioners and the Fort Wayne Civic Improvement Association are working in conjunction to secure a uniform ornamental street lighting system for the business section of the city. Samples of lamp standards and lamps are being asked for and a committee has been appointed to make the selection.

SOUTH BEND, IND.—The control of the South Bend Home Telephone Company has passed to the Automatic Electric Company, of Chicago. The company operates seven exchanges in South Bend and vicinity. Sanford F. Harris, of Chicago, Ill., is president, and Elmer E. Daley is general manager.

SWAYZEE, IND.—The Swayzee Co-operative Telephone Company has increased its capital stock by $2,500, the proceeds to be used to improve and enlarge its plant.

WARSAW, IND.—The Winona Electric Light & Water Company is reported to be contemplating improvements to its system, including the installation of new pumps.

ADAIR, IA.—The W. K. Palmer Company, of Kansas City, Mo., is reported to be preparing plans for the installation of an electric-light plant and water-works system in Adair, for which bonds to the amount of $30,000 were recently authorized.

ALBIA, IA.—The Albia Interurban Railway Company is planning to extend its railway from Albia to Baxton, a distance of nine miles.

CORYDON, IA.—Bids will be received by the City of Corydon, Ia., until Feb. 28 for the construction of three miles of sewers and a disposal plant, six miles 4 to 8-in. water mains, 70,000-gal. steel tank on 100 ft. tower. Bids will also be received at the same time for pump house and reservoir, hydrants, valves, etc., triplex pump and deep well pump, 15-hp and 30-hp motors and electrical equipment. Plans are on file at the office of the Iowa Engineering Company, Chase Block, Clinton, Ia., copies of which may be obtained for $5 each job.

EAST PLEASANT PLAIN, IA.—The local exchange of the Pleasant Plain Telephone Company was recently destroyed by fire.

WAPELLO, IA.—The Iowa Telephone Company is contemplating improvements to its telephone exchange, involving an expenditure of about $8,000.

KANSAS CITY, KAN.—The question of purchasing the local electric-light plant to be owned and operated by the municipality is under consideration. It is proposed to issue bonds to the amount of $350,000, the proceeds to be used to buy the plant and improve the same. J. L. Porter is Mayor.

SYLVAN GROVE, KAN.—Plans are being considered for the installation of an electric-light plant and water-works system in Sylvan Grove. The cost of the proposed work is estimated at about $35,000, bids for which will be called for about July 1, 1911. George P. Taylor, of Stockton, Kan., is engineer in charge. W. H. Breihan is city clerk.

HARRODSBURG, KY.—James Lloyd and others are contemplating erecting a telephone line from the local telephone exchange to the Cedar Grove district. The erection of a telephone line from Harrodsburg to Duncan is reported to be under consideration.

LOUISVILLE, KY.—Proposals will be received at the office of Samuel D. Jones, business director of the Board of Education, Administration Building, Eighth and Chestnut Streets, Louisville, Ky., until Feb. 24, for furnishing and installing chairs in the assembly room and furnishing electric-light fixtures at the Broadway School. Plans and specifications may be seen at the above office or at the office of Brinton B. Davis, architect, Atherton Building, Louisville, Ky.

WHITESBURG, KY.—It is reported that the Eastern Kentucky Home Telephone Company, which recently purchased systems of the Whitesburg Telephone Company and the Letcher County Home Telephone Company, is contemplating improvements and extensions, including the installation of an exchange in Whitesburg, rebuilding toll lines and connecting with long-distance lines from Stonega, Va., to Pikeville, Ky. The main office of the company is located in Pikeville, Ky. M. Starkey is general manager.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company, recently incorporated to build an electric railway from New Iberia to Lafayette, a distance of seventy-five miles, it is reported, will begin work on survey of the proposed railway within a few weeks. It is understood that financial arrangements have been made. The company is capitalized at $1,500,000. F. W. Crosby, of New Orleans, La., is president.

BALTIMORE, MD.—The directors of the Consolidated Gas, Electric Light & Power Company have authorized, subject to ratification by the stockholders, an issue of $1,500,000 in common capital stock to be offered to the stockholders at par, of which the proceeds of $735,000 will be used to retire $700,000 preferred stock at $105. A special meeting of the stockholders will be held March 1 to vote on the proposition.

CHESTERTOWN, MD.—The Kent Traction Company, recently incorporated, proposes to build an electric railway to connect Tolchester, Fairlee, Georgetown and Chestertown, ten miles in length, for which, it is said, rights of way have been secured. It is also proposed to build a branch to Rock Hall. The company is capitalized at $200,000. Frederick G. Usilton, Wilbur W. Hubbard, J. H. Sidds and T. D. Bowers are among the incorporators.

BOSTON, MASS.—The New York, New Haven & Hartford Railroad Company has presented a bill to the State Legislature submitting a proposition for the acquisition of the Boston, Revere Beach & Lynn Railroad, under the terms of which the New York, New Haven & Hartford Company agrees to construct another tunnel beneath the harbor, an underground connection with the New Haven system and the extension of the Revere Beach line to Beverly; also to equip the Revere Beach road for electrical operation. The plan also includes a connection with the eastern division of the Boston & Maine Railroad, which is now controlled by the New Haven company.

BOSTON, MASS.—Sealed bids will be received at the office of the Constructing Quartermaster, 263 Summer Street, Boston, Mass., until March 15 for construction, plumbing, heating, electric wiring and fixtures for one quarters for commissioned officers, two quarters for non-commissioned officers, one quarters for field officer, addition to post hospital, for construction, plumbing, electric wiring and fixtures for fire station, and construction complete of storehouse and shop building at Fort Andrews, Mass. Plans can be seen, specifications, blank forms and full information obtained at the above office. Plans and specifications can also be seen at the office of the Chief Quartermaster, Department of the East, Governor's Island, New York Harbor. A deposit of $25 will be required for plans and specifications. Captain A. M. Miller is constructing quartermaster.

FALL RIVER, MASS.—The Standard Fabric Company has purchased a site on South Watuppa Lake and will begin work on construction of its plant as soon as the weather will permit. The building will be 220 ft. x 88 ft., three stories high. The company will manufacture novelties in laces, ribbons, tapes, etc. The plant will be equipped for electrical operation. Edward T. Marvell is architect and engineer.

GRANITEVILLE, MASS.—The Lowell Electric Light Corporation has petitioned the Westford Board of Selectmen for locations for its poles and wires in this village. At present many houses are being wired for electric lamps. It is expected that the proposition for street lighting will be submitted to the voters at the annual town meeting in March.

SALEM, MASS.—Plans are being prepared by City Electrician Ashby for placing the municipal fire alarm, police and telephone wires in conduit, the cost of which is estimated at about $40,000. About six miles of cable will be required. The city passed a law requiring all wires in the business section of the city to be placed underground.

MANISTEE, MICH.—The proposition to issue $90,000 in bonds for the construction of a municipal electric-light plant is reported to be under consideration.

SAULT STE. MARIE, MICH.—The City of Sault Ste. Marie has made formal application to the War Department, Washington, D. C., for the lease of the Chandler Dunbar water-power canal taken over by the United States on condemnation proceedings. Some time ago the city voted to install a municipal electric-light plant and proposes to develop the water power of the canal to provide power to operate the proposed electric plant and waterworks system.

DULUTH, MINN.—At a recent election the proposition to issue $300,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and improvements to the waterworks, was carried. C. S. Palmer is city clerk.

DULUTH, MINN.—The Minnesota Canal Power Company, which for ten years has been securing the right of way, flowage rights and other privileges in connection with the operation of its proposed hydroelectric power plant, is about to enter the head of the lakes. Water will be secured from the St. Louis River above Cloquet. It is proposed to construct a canal from Cloquet to the hill back of Ironton, ending in a flume which carries the water to the big turbines in the plant. The water will have a drop of 600 ft. from the top of the hill to the power plant. It is estimated that 80,000 hp can be developed, which will be transmitted to Superior, Wis., and Duluth, Minn. The company has been granted a permit by the government for the construction of the canals.

MINNEAPOLIS, MINN.—Preliminary plans are being prepared by the City Council health and hospitals committee for furnishing light and heat to the new Hopewell Hospital, light for Camden Park and power for the Northeast pumping station from the crematory plant. The committee has decided to purchase a generator, to cost $3,000, to furnish service to the Hopewell Hospital. J. W. Allen, park commissioner, was requested to submit a proposition to the Park Board to supply electricity for lighting Camden Park for 5 cents per kw-hour. The Minneapolis General Electric Company asks 10 cents per kw-hour for the same service. It is estimated that 400 hp could be supplied to the Northeast pumping station to operate the new electrical pumps. Application has been made to the State Legislature for authority to issue $100,000 in bonds for improvements to the plant.

VIRGINIA, MINN.—A petition has been presented to the City Council asking it to purchase the local electric light plant and water-works system or to build new systems.

McCOMB, MISS.—The construction of a municipal electric-light plant in McComb is reported to be under consideration.

NEWTON, MISS.—It is reported that an ordinance has been passed by the Mayor and Board of Aldermen providing for an issue of $11,000 in bonds, the proceeds to be used for the construction of an electric-light plant.

CHILLICOTHE, MO.—Plans have been prepared by Fuller-Coult Company, Chemical Building, St. Louis, Mo., for the construction of a municipal electric-light plant in Chillicothe, Mo., for which bonds to the amount of $50,000 have been issued.

COLE CAMP, MO.—It is reported that the proposition to issue bonds to the amount of $10,000, the proceeds to be used for the installation of an electric light plant and water-works system, will be submitted to a vote at an election to be held in April.

FORSYTH, MO.—The Ozark Power & Water Company, recently organized, is contemplating the construction of a hydroelectric power plant on the White River, three miles from Forsyth. The present plans of the company contemplate the development of 2500 hp, at a cost of about $400,000.

KANSAS CITY, MO.—The Kansas City, Lawrence & Topeka Electric Railway Company is planning to build an extension between Zarah and Lawrence, a distance of twenty-four miles, during 1911.

KANSAS CITY, MO.—Plans are being made by the Interstate Railway Company for extensions to its system during 1911, which will call for the construction of forty-eight miles of main track and five miles of sidings.

MARIONVILLE, MO.—The Lawrence County Water, Light & Cold Storage Company, of Aurora, Mo., is reported to have secured a fran-

chise in Marionville to construct and operate an electric-light plant and water-works system, to cost approximately $40,000.

MONETT, MO.—It is reported that bonds to the amount of $35,000 will be sold by the City of Monett to provide funds for the construction of an electric-light plant, plans and specifications for which have been prepared by Rollins & Westover, engineers, Beals Building, Kansas City, Mo. It is expected that contracts for construction of the plant will be awarded soon.

ST. LOUIS, MO.—It is reported that the Union Electric Light & Power Company, of St. Louis, Mo., has taken over the contract which the Laclede Gas Light Company made with the corporation which is to build a large hydroelectric plant at Keokuk, Ia., and transmit electrcitiy to St. Louis. The contract calls for 4000 hp and runs for ninety-nine years. Alton S. Miller is president of the Union Electric Light & Power Company.

GORDON, NEB.—At a special election held recently, it is reported, the citizens voted in favor of the proposition to issue bonds for the installation of electric-light, sewer and water-works systems.

ORD, NEB.—The City Council is contemplating issuing bonds for the purchase of the local electric-light plant.

VALENTINE, NEB.—It is reported that the city will install its own street-lighting system as soon as the new dam, which is being built by the municipality, is completed.

MADISON, N. J.—The Council has adopted the recommendations of the light committee and voted to authorize an expenditure of $16,687 for improvements and extensions to the municipal electric plant.

ROSWELL, N. M.—Plans are being prepared by the Berrendo Irrigation Farms Company, which, it is reported, has purchased the property of the Roswell Electric Light & Power Company, for extensions and improvements to its system, involving an expenditure of about $250,000. Additional buildings will be erected and new machinery installed. It is expected that work will begin on the proposed improvements within two months.

ODGENSBURG, N. Y.—Announcement has been made by the Odgensburg Power & Light Company of a reduction in the price of gas to $1.50 per 1000 cu. ft. Arrangements are being made by the company to enlarge its gas plant at a cost of about $16,000. The company, which also controls the street railway, is planning to erect a new car barn.

HANKINSON, N. D.—Application has been made to the Council by H. G. Squires, of Galesburg, Ill., for a franchise to operate an electric-light plant in Hankinson.

AKRON, OHIO.—The City Council is considering the question of constructing a municipal electric light plant. The Northern Ohio Traction & Light Company has the present contract for lighting the city, which will soon expire.

CINCINNATI, OHIO.—Sealed proposals will be received at the office of Director of Public Works, City Hall, Cincinnati, Ohio, until Feb. 28, for lighting streets, lands, lanes, squares and public places of the City of Cincinnati, excepting all the property under the control of the Board of Park Commissioners, for a period of ten years, beginning June 1, 1912. Plans and specifications and blank proposals can be obtained at the office of the Director of Public Service. John J. Wenner is clerk.

CLEVELAND, OHIO.—Only one bid was received for furnishing light and heat for the city hall building, which was submitted by the Cleveland Electric Illuminating Company, in which it agreed to supply the service for $13,596. It is said the bid will be rejected and the plant in the basement of the city hall will be rehabilitated.

COLUMBUS, OHIO.—The contract for electrical work for the New Hartman Theatre Building, including the theater, has been awarded to the Avery-Loeb Company, North Third Street, Columbus, Ohio. The cost of the work is estimated at about $25,000. Richards, McCarty & Butford, are architects.

LORAIN, OHIO.—The River Telephone Company, of Lorain, has filed amendments to its charter increasing its capital stock from $100,000 to $300,000.

YOUNGSTOWN, OHIO.—Plans have been prepared by the Banner Electric Company for large extensions to its plant on the South Side, which will involve an expenditure of about $250,000. The company manufactures incandescent lamps.

HOLLIS, OKLA.—The Chickasha Cotton Oil Company is reported to be contemplating the installation of an electric light plant and ice plant in connection with its oil mill. R. G. Latting is general superintendent.

OKLAHOMA, OKLA.—The Western Power & Irrigation Company, of Oklahoma City, Okla., has increased its capital stock from $200,000 to $500,000, the proceeds to be used for the construction of an electric railway from Cordell to Colony, Okla., work on construction of which is expected to begin within a year. The company at present is installing a hydroelectric power plant at Mountain View, Okla., near which a dam has already been completed across the Washita River by the Ambursen Hydraulic Construction Company. The plant, when completed, will supply electricity for lamps and motors for the towns in the Washita Valley. The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., of which W. F. Barnes is State representative, is installing the plant. C. T. Berryman is president of the Western Power & Irrigation Company, and George W. Fry secretary and treasurer.

PAWHUSKA, OKLA.—The Pawhuska Water & Electric Light Department is contemplating the installation of 12,000 ft. of No. 2 weather-proof copper wire, and is in the market for one second-hand 125 or 150-kw, single-phase, 60-cycle, 2300-volt alternator, revolving armature, compound wound, Westinghouse or General Electric preferred. L. P. Caldwell is superintendent.

SENTINEL, OKLA.—The proposition to issue $12,000 in bonds, the proceeds to be used for the construction of an electric light plant, will be submitted to a vote at an election to be held in March.

EAGLE POINT, ORE.—Arrangements are being made for the construction of an electric-light plant on Little Butte Creek, near Eagle Point, to supply electricity for lamps and motors in this village. It is understood that surveys have been made and a dam site located. Eastern capitalists are reported to be interested in the project.

SPRINGFIELD, ORE.—The contract for the construction of the power house of the Oregon Power Company in Springfield has been awarded Sherman & Hunter, of Eugene, Ore.

VALE, ORE.—Plans are reported to be under way whereby electricity will soon be transmitted to Vale from the power plant on the Malad River, Idaho, owned by the Telluride Company, Salt Lake City, Utah.

BRADFORD, PA.—The Bradford Electric Light & Power Company has recently placed a contract for a 375-hp horizontal gas engine with the Westinghouse Machine Company, of Pittsburgh, Pa. The engine will be direct-connected to a Westinghouse 250-kva, 2400-volt, 60-cycle, 3-phase generator. Natural gas will be used for fuel.

ETNA, PA.—It is reported that plans have been prepared for the construction of an electric light plant and pumping station in Etna, to cost about $50,000.

HARRISBURG, PA.—Two bills have been presented to the State Legislature by Representative Mills, of Bradford County, as amendments to existing acts, giving to electric light, heat and power companies the right of eminent domain and authorizing such companies to supply light, heat and power to any city, township or borough in this or an adjoining State. It is understood that the bills were introduced in behalf of the McCall's Ferry Power Company, which is operating a large hydroelectric power plant on the Susquehanna River.

HAZEL DELL, PA.—The residents of the Borough of Hazel Dell are considering the question of installing an electric light plant. The proposition may be submitted to a vote at an early date.

LOCK HAVEN, PA.—The City Council has instructed the Light and Sanitary Committee to ask for bids for lighting the streets by electricity, and also to ask for bids for the construction of an electric plant to be owned and operated by the city. The Lock Haven Electric Light & Power Company has the present contract for street lighting, which will expire in about six months.

NORRISTOWN, PA.—Announcement has been made by the Montgomery County Rapid Transit Company, which operates the Trooper-Souderton electric railway, to extend its electric railway from Skippack to Schwenksville, and thence to Green Lane and Pennsburg. Daniel M. Auders and Henry J. Farquhar are receivers.

PHILADELPHIA, PA.—Among the improvements planned by Mayor Reyburn is the construction of a four-track subway to run the entire length of Broad Street, a distance of eleven miles, to be controlled by the city and leased; the extension of the Market Street subway system of the Philadelphia Rapid Transit Company to Camden, N. J., through tunnel under the Delaware River, and the erection of a large convention hall on the edge of Fairmount Park. The proposed improvements, it is said, are to be made under a $60,000,000 city loan, of which $28,000,000 will be spent on the Broad Street Subway. It is understood that steps have already been taken to have the loan approved by the State Legislature.

PROVIDENCE, R. I.—At the annual meeting of the Providence Telephone Company the stockholders voted to increase the capital stock of the company from $3,000,000 to $5,000,000, to be issued at the discretion of the directors. Of this $500,000 will be issued at once.

ROCK HILL, S. C.—The City of Rock Hill has purchased the property of the Rock Hill Water & Electric Company, consisting of the water-works system, electric-light plant and street railway, which will be operated by the municipality. The consideration was $100,000, for which the city will soon issue bonds to pay for same and will take over the plants at once. Martin Maloney, of Philadelphia, Pa., is president of the Rock Hill company.

ST. GEORGE, S. C.—It is reported that the question of issuing $17,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system, is under consideration.

BRYAN, TEX.—The City Council is reported to have accepted the proposition submitted by H T. and J. S. Lawler, of New Orleans, La., for the erection of a flour mill and installation of an electric-light plant to supply electricity for lamps and motors in Bryan and also to furnish water and to build a sewerage system. The cost of the mill and power plant is estimated at $50,000.

MEMPHIS, TENN.—Plans are being considered for the construction of a municipal electric light plant in Memphis. It is proposed to issue $1,000,000 in bonds to provide funds for same. It will be necessary to secure permission from the State Legislature to issue the bonds.

MILES, TEX.—The local electric light plant, owned and operated by S. M. and T. J. Farmer, was destroyed by fire Feb. 5, causing a loss of about $10,000.

NAPLES, TEX.—It is reported that Charles E. Grant and M. H. Sullivan are contemplating installing an electric-light plant in Naples.

SAN MARCOS, TEX.—The San Marcos Utilities Company is reported to have been granted a franchise to supply electricity for lamps in San Marcos. The company contemplates making improvements to its plant, to cost approximately $10,000.

LOGAN, UTAH.—K. C. Schaub, who has been preparing estimates of the cost of remodeling the city water-works system, has submitted his report to the City Council, in which he estimates the cost at $112,000 if cement conduits are used and $93,000 if the conduits are made of wood. The plans include the construction of a conduit 5600 ft. long, extending from DeWitt springs to the head of the present power plant site. In that distance a fall of 194 ft. could be secured, which would be available for power purposes. The proposition to bring this power to the mouth of the canyon to be used for generating electricity for the Agricultural College is also under consideration.

CHASE CITY, VA.—Contracts have been awarded for construction and equipment of the Chase City municipal electric light plant as follows: For construction work and electrical equipment, to John L. Livers, of Grottoes, Va., and to the Erie City Iron Works, of Erie, Pa., for boiler and engine. J. Kent White, of Crewe, Va., is engineer.

WAVERLY, VA.—It is reported that bonds to the amount of $7,000 have been voted, the proceeds to be used for the installation of an electric-light plant and street improvements.

SPOKANE, WASH.—Among the improvements contemplated by the Washington Water Power Company are the following: Completing water-power developments at Little Falls, construction of new power plant above Little Falls, securing more flowage rights in the Spokane River and Cœur d'Alene Lake, placing all wires underground in Spokane, extension to the local light and power systems, completing the construction of storage battery plant in Spokane, the installation of additional machinery in the local substation, the erection of a transmission line from Pond d'Oreille to Newport, Wash., the construction of new track and purchase of new cars, etc. The company is reported to have awarded the contract for four large water-wheels, having a total rating of 90,000 hp, to the I. P. Morris Company, of Philadelphia, Pa. D. L. Huntington is president and manager.

TOPPENISH, WASH.—The Valley Light & Power Company, it is reported, is extending its transmission lines to Zillah, Wash.

BOWLING GREEN, W. VA.—The Bowling Green Home Telephone Company, it is said, is contemplating making extensions to its system, which will involve an expenditure of about $10,000.

BUNGERS, W. VA.—Slater S. Tuckwiller is reported to be planning to install an electric light plant. It is understood that it is proposed to develop a water-power.

BARABOO, WIS.—Reports have been filed showing the cost of the proposed municipal electric-light and power plant to be approximately $45,000. The alternative proposition is purchasing current from the Wisconsin River Power Company at Prairie du Sac, which involves the erection of a substation and distributing system at a cost of $30,000. No action has been taken, but the prevailing sentiment is in favor of a municipal plant.

CHIPPEWA FALLS, WIS.—The plants and holdings of the Chippewa Falls Water Works & Lighting Company have been purchased by the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis. The property will hereafter be conducted and operated under the name of the Chippewa Valley Railway, Light & Power Company. George B. Wheeler is secretary and general manager.

LADYSMITH, WIS.—Plans are being made by the Chippewa Valley Telephone Company for further improvements to its system, including the extension of its cable lines.

NEW LONDON, WIS.—It is reported that a farmers' telephone line has been organized in New London to be a tributary to the Fox River lines.

LETHBRIDGE, ALTA., CAN.—City Engineer Arnold, who has been making investigations regarding street railways, recommends the City Council to build the proposed municipal railway system at once.

PINCHER CREEK, ALTA., CAN.—The town of Pincher Creek is asking for bids for an issue of $22,000 debentures, the proceeds to be used for the purchase of the local electric-light plant, owned by the Pincher Creek Electric Light Company. G. D. Plunkett is secretary and treasurer.

NELSON, B. C., CAN.—It is reported that electricity from the municipal electric plant is being supplied to consumers at less than cost. An increase in rate has been ordered which will go into effect at once.

NELSON, B. C., CAN.—The Nelson Street Railroad Company is contemplating improvements to its system, to cost about $10,000.

PRINCE RUPERT, B. C., CAN.—Bids will be received by the City of Prince Rupert, B. C., until March 2, for $40,000 telephone debentures. Ernest A. Woods is city clerk.

ARGYLE, MAN., CAN.—Arrangements have been made by the Municipality of Argyle whereby the Manitoba government will take over the municipal telephone system and add it to the provincial system.

NEEPAWA, MAN., CAN.—Plans are being prepared by the Manitoba Telephone Commission for the erection of a new telephone exchange in Neepawa.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company is planning several extensions to its system, including a line to Winnipeg Beach, this year.

LIVERPOOL, N. S., CAN.—Surveys are being made, it is said, in connection with a project to develop extensive water powers in this vicinity to be used to generate electricity. J. L. McLeod and George S. McLaren, of Liverpool, N. S., are reported to be interested in the enterprise.

FORT WILLIAM, ONT., CAN.—The Kaministiquia Power Company is planning to enlarge its plant near Fort William, for which $250,000 has been appropriated.

GUELPH, ONT., CAN.—It is reported that bids are being received by the Street Railway Commission for construction of an extension of the Guelph Radial Railway in St. Patrick's Ward.

HAMILTON, ONT., CAN.—Applications, accompanied by qualifications and testimonials, will be received by the city clerk until March 15 from electrical engineers for the purpose of preparing estimates of the cost, plans and specifications for a municipal electric power and light system for the City of Hamilton. S. H. Kent is city clerk.

HAMILTON, ONT., CAN.—The City Council is reported to be considering the purchase of the plant of the Cataract Power Company to be operated by the municipality.

OTTAWA, ONT., CAN.—The Morrisburg & Ottawa Electric Railway Company is reported to have applied for a franchise to construct an electric railway on Main Street to connect with the Ottawa Street Railway. C. M. Willard, of Morewood, Ont., Can., is president of the company.

OTTAWA, ONT., CAN.—An amendment is proposed to the provincial hydroelectric power act which will enable the furnishing of electricity for lamps and motors to farmers along the line of the Hydro-Electric Power Commission system with branches to adjacent settlements.

RENFREW, ONT., CAN.—It is reported that investigations are being made by the engineers of the Hydro-Electric Power Commission of the upper lakes of Bonnechere River, for the purpose of locating sites for dams for storage purposes. The town of Renfrew is expending $150,000 for power development.

ABERDEEN, SASK., CAN.—Several applications for power having been made to the provincial government, the town of Aberdeen has requested that at least one-third of the power at La Colle Falls be reserved for its own use.

ABERNETHY, SASK., CAN.—The D Line Rural Telephone Company is contemplating building a number of extensions to its system in the spring.

ASQUITH, SASK., CAN.—Plans are being prepared by the provincial telephone department for the erection of a long-distance telephone line between Saskatoon and Biggar, passing through this town.

GRENFELL, SASK., CAN.—The Board of Trade has organized telephone companies in the rural districts of Weldon and Brownhill and is now planning to form a company in the Tetlock district.

KERROBERT, SASK., CAN.—Arrangements are being made by the civic authorities for the installation of a municipal electric light plant in Kerrobert.

KERROBERT, SASK., CAN.—The Kerrobert Board of Trade has applied to the Saskatchewan government for a local telephone system and connection with the long-distance telephone lines in the province.

MOOSEJAW, SASK., CAN.—The Moosejaw Electric Company has applied for a charter to build a street railway system in Moosejaw and to adjoining towns. The company will be capitalized at $500,000. D. R. Street, A. H. Dion and N. J. Kerr, all of Ottawa, Ont., are interested in the project.

REGINA, SASK., CAN.—A bill is now before the Legislature which provides for a tax of 2 cents per acre on all land in the province for telephone purposes.

WOLSELEY, SASK., CAN.—Announcement has been made by the Saskatchewan government that it proposes to build a long-distnace telephone line from Wolseley to the Manitoba boundary.

YORKTON, SASK., CAN.—The civic authorities have decided to offer for sale the plant of the Yorkton Northwest Telephone Company to the Saskatchewan government.

PACHUCA, MEX.—The Cia Beneficiandora de Pachuca de Mexico has recently purchased one 195-kva, oil-insulated, self-cooling auto-transformer from the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The 3-phase, 10,000-volt high-tension-6600-volt low-tension transformer is designed to operate on either 50 cycles or 60 cycles and will connect together two systems, one of 10,000 volts and the other of 6600 volts in case of failure of either system. The transformer will be able to switch the 1000-hp load of a compressor motor from one circuit to the other in case of failure of the circuit that is operating.

New Industrial Companies.

THE ADSIT TELEPHONE MANUFACTURING COMPANY, of St. Paul, Minn., has been incorporated with a capital stock of $500,000. The company proposes to manufacture telephones and telephone supplies. G. N. Berrgren is president and G. E. Adsit, vice-president.

THE ATWOOD VACUUM CLEANER COMPANY, of Rockford, Ill., has been chartered with a capital stock of $50,000 by James T. Atwood, Howard C. Atwood and Myra C. Atwood. The company proposes to manufacture and deal in electrical machinery.

THE CHARLES H. DEBS COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 to manufacture and deal in electric and gas fixtures. The incorporators are: Charles L. Cohns, Charles H. Debs and Joseph Rosenberg.

THE DENNISTON COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $150,000 by E. E. Denniston, E. C. Anderson and F. U. Browne, of Buffalo, N. Y. The company proposes to manufacture motors, engines, machinery, etc., also vehicles of all kinds.

THE FOREST CITY ENGINEERING COMPANY, of Cleveland, Ohio, has been incorporated by William von Wolffradt, E. von Wolffradt, L. H. Miller, N. S. J. Zwick and R. E. Needham. The company is capitalized at $10,000 and proposes to do general engineering work.

THE GRAVITY CONDENSER COMPANY, of Milltown, N. J., has been incorporated by G. Reimers, M. Reimers, of Milltown, N. J.; F. A. Sondheimer and G. L. Sondheimer, of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture condensers and machinery.

INDEPENDENT FIXTURE COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $5,000 to manufacture and deal in gas and electric-light fixtures, etc. The incorporators are: P. L. Utley, Ralph Utley and Elmer E. Challenger.

THE LARRABEE ELECTRICAL COMPANY, of Portland, Maine, has been organized with a capital stock of $10,000 for the purpose of manufacturing electrical supplies. The incorporators are: H. Perkins, president; Henry C. Larrabee, treasurer; G. H. Sturgis, clerk; Frank M. Larrabee and Clifford S. Libby, all of Portland, Maine.

THE LEWIS ELECTRIC WELDING & MANUFACTURING COMPANY, of Toledo, Ohio, has been incorporated by G. L. Lewis, Frank W. Otis, Ewald Preus, H. W. Fraser and E. J. Marshall. The company is capitalized at $10,000 and proposes to manufacture electrical and mechanical appliances.

THE LEXINGTON MACHINE WORKS, of Lexington, Ky., has filed articles of incorporation with a capital stock of $12,000 and proposes to manufacture gas engines and special machinery.

THE MERRITT ENGINEERING COMPANY, of Elizabeth, N. J., has been incorporated with a capital stock of $250,000 by Horace R. Wemple, of Elizabeth, N. J.; Ernest Wemple, of Cranford, N. J., and Daniel W. Merritt, of Brooklyn, N. Y. The company proposes to manufacture and sell oil engines, etc.

THE METEOR AUTO TANK COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000, for the purpose of manufacturing automobile tanks, lamps, etc., chandeliers, electroliers, etc. The incorporators are: G. Leveene, E. J. Bosse and S. J. Mayes, of New York, N. Y.

THE NEW JERSEY MOTOR EQUIPMENT COMPANY, of Elizabeth, N. J., has been chartered with a capital stock of $100,000 by G. Sesber, of Richmond, N. Y.; E. Nugent and L. Hoffman, of Elizabeth, N. J. The company proposes to manufacture machinery and patents for mechanical appliances, etc.

THE PENNSYLVANIA RAILWAY MOTOR COMPANY, of Warren, Pa., has been incorporated with a capital stock of $200,000. The directors are: R. N. Brown, of Warren, Pa., treasurer; J. A. Veile, Frank M. Knapp, O. W. Ensworth, all of Warren, Pa.

THE WARDER, CLARK & CHAPLIN COMPANY, of Rochester, N. Y., has been incorporated by Charles Warder, 233 Tremont Street, Rochester, N. Y.; Jay R. Clark, Ironequoit, N. Y., and Edwin R. Chaplin, 36 Monroe Avenue, Rochester, N. Y. The company is capitalized at $12,000 and proposes to do general electrical construction work and deal in electrical apparatus and supplies.

THE WILSON MOTOR STARTER COMPANY, of Franklin, Pa., has been chartered with a capital stock of $30,000. The directors are: William McC. Wilson, of Franklin, Pa., treasurer; John A. Wilson and G. J. Spohrer, all of Franklin, Pa.

THE WINTER BATTERY COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $10,000 to manufacture and deal in batteries and kindred articles. The incorporators are: H. C. Bangs, Harry Rubens, Jr., and Carey W. Rhodes.

New Incorporations.

SAN FRANCISCO, CAL.—The Monterey & Pacific Grave Telephone Company has been incorporated with a capital stock of $100,000 by E. C. McGee, C. Bull, J. D. O'Connell, R. C. Smith and H. Haber.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the California Telephone Herald Company with a capital stock of $1,000,000 by G. S. Holbrook, W. A. Whelan, W. B. Heckmann, A. H. Vorrath, R. M. Graham, B. Boreham, William T. Newverth, A C. Gould and A. Jacoby.

COIN, IA.—The Buck Creek Mutual Telephone Company has been chartered with a capital stock of $5,000 by H. M. Myers, Frank Annam, H. D. Ellis, W. L. Annam, Herman Seifering, Henry Muller and J. H. Meyers.

WEST POINT, IA.—The West Point Mutual Telephone Company has been incorporated with a capital stock of $20,000. The officers are: J. W. Piper, president; J. C. Junkunz, secretary, and J. H. Richardson, treasurer.

ALBANY,, ILL.—The Albany Telephone Company has been incorporated with a capital stock of $3,000 by E. B. Dimond, Herbert J. Simpson and T. H. Adams.

BOSTON, MASS.—The North Boston Lighting Company, which is an amalgamation of several lighting companies in the vicinity of Boston, in which considerable New Haven capital is invested, has been organized. The trustees are: Herbert C. Warren, Edward M. Bradley and Samuel A. York.

POINDEXTER, R. F. D., SILOAM, N. C.—The Poindexter Telephone Company has been incorporated with a capital stock of $3,250 by O. J. Martin, H. J. Mickey and others.

EPPING, N. D.—The Epping Telephone Company has been incorporated with a capital stock of $25,000 by O. Ellingson, C. F. Carpenter, Charles O. Edell, R. L. Hambleton and John Hannegrafs, all of Epping.

BARBERTON, OHIO.—The Barberton Light & Power Company has been incorporated with a capital stock of $10,000 by Charles L. Johnson, F. A. Fobes, A. L. Miller, F. M. Clay and E. J. Quigley. The company will lease the electric plant of the Barberton Inn and supply electricity for residential lighting in Barberton.

BREWSTER, R. F. D. NAVARRE, OHIO.—The North Brewster Electric Light, Heat & Power Company has been chartered with a capital stock of $5,000 by J. P. Thomas and others.

GENEVA, OHIO.—The People's Telephone Company has been incorporated by C. J. Crowther, G. M. Surridge, H. Buff and George J. Bradley.

MONROE, OKLA.—The Monroe Telephone Company has been incorporated with a capital stock of $1,000 by C. E. Riggan, J. H. Banning, B. D. Woodson, W. J. Gasaway, W. F. Hunt and E. A. Flynn.

HELLERTOWN, PA.—The Lower Saucon Telephone Company has been incorporated with a capital stock of $5,000. The directors are: Theodore F. Laubach, of Hellertown, Pa., R. F. D. No. 2, treasurer; Daniel M. Weber, Edward J. Schaeffer, John B. Boyer, Stewart C. Riegel and Titus W. Weaver, all of Hellertown, Pa.

HELLERTOWN, PA.—Articles of incorporation have been filed for the Sadsbury Township Electric Company with a capital stock of $5,000. The directors are: Theodore F. Laubach, of Hellertown, R. F. D. No. 2, treasurer; Daniel M. Weber, Edward J. Schaeffer, John B. Boyer, Stewart C. Riegel and Titus W. Weaver, all of Hellertown, Pa.

WEST CHESTER, PA.—The East Bradford Light, Heat & Power Company and the West Goshen Light, Heat & Power Company have been granted charters. Both companies are capitalized at $5,000 and the directors are: Benjamin W. Haines, of West Chester, Pa., treasurer; Samuel Marshall, of West Goshen township; Marshall H. Matlack, of West Chester, Pa.

KYLE, TEX.—Articles of incorporation have been filed for the Kyle Telephone Company with a capital stock of $5,000 by C. F. Heidenrich, T. F. Harwell, P. Allen and others.

SUNSET, TEX.—Articles of incorporation have been filed for the Sunset Heights Water, Light & Power Company with a capital stock of $20,000 by Richard Rodgers, B. R. Hardin and W. E. Courtney.

CLAUDVILLE, VA.—The Three-Fork Telephone Company has been chartered with a capital stock of $5,000 and the following officers: A. T. Jessup, president; W. H. Waller, vice-president, and J. H. Barnard, secretary and treasurer.

SHAWSVILLE, VA.—The North Fork & Bradshaw Telephone Corporation has been incorporated with a capital stock of $5,000. The officers of the company are: F. T. Sesler, president; S. W. Kenzie, vice-president, and G. C. Bain, secretary and treasurer.

CHEHALIS, WASH.—The Chehalis & Cowlitz Railway Company has been chartered with a capital stock of $300,000 by H. Coffman and George Robinson, of Chehalis, Wash. The company proposes to construct a steam or electric railway from Chehalis to a point on the Cowlitz River.

WOLSELEY, SASK., CAN.—The Westfield Rural Telephone Company has been incorporated to build a rural telephone system southeast of this city. S. Fleming is secretary pro tem.

Personal.

Mr. W. GODFREY BOYD has resigned from the sales department of Lamont, Corliss & Co. to become manager of the sales department of the New York Incandescent Lamp Company.

MR. ELAM MILLER has been appointed commercial engineer of the Pacific Telephone & Telegraph Company, reporting to the general commercial superintendent at San Francisco.

MR. J. W. M. BURTON has resigned as secretary and manager of the Paxton Electric Company, of Paxton, Ill., to accept a position as salesman for the Mills Electric Company, of Peoria, Ill.

MR. F. F. BARBOUR, assistant to the president of the Portland (Ore.) Railway, Light & Power Company, has resigned his position to accept a similar one with the Pacific Gas & Electric Company of San Francisco.

MR. F. H. COOKE, general agent for the Illinois Traction System at St. Louis, Mo., recently delivered an address before the St. Louis Sales Managers' Association upon "The McKinley System and the St. Louis Market."

MR. C. E. THATCHER, who lately arrived on the Pacific Coast from the East, has been appointed city manager of the Western Union Telegraph Company in San Francisco to fill the vacancy created by the resignation of W. A. Newcomb.

MR. D. McFARLAN MOORE will lecture before the department of electrical engineering of Columbia University, New York, on Friday, February 24, at 8 p. m., on tube lighting. The address will be illustrated by numerous interesting lantern slides.

MR. W. H. DE WITT has succeed Mr. Frank Arnold as operating superintendent of the Fort Dodge, Des Moines and Southern Railroad at Ames, Iowa. Mr. F. M. Johnson is purchasing agent; Mr. H. W. Fisk, electrical engineer, and Mr. W. R. Dyer, claim agent

MR. S. O. OCHS of the Russian Importing Company, Boston, Mass., sailed for Russia on the *Kaiserin Auguste Victoria* on Feb. 11. Mr. Ochs represents several American manufacturers of electrical and other apparatus which is being introduced to the Russian public.

MR. ARTHUR P. PIERSON, who has for the past five years been actively identified with the general electric supply business, has been appointed exclusive agent for New York and vicinity for the Brilliant Electric Company, of Cleveland, Ohio, manufacturers of all types of incandescent lamps.

MR. J. LE CONTE DAVIS presented a paper on "The Electric Locomotive of the Pennsylvania Railroad," at the February meeting on Friday Feb. 17, of the Baltimore Section of the American Institute of Electrical Engineers. The meeting was held in the physical laboratory of Johns Hopkins University, and the paper was illustrated by projections from lantern slides.

MR. FRANK KOESTER, previously with the Interborough Rapid Transit (Subway) Construction Company, the J. G. White Company, the Guggenheim Exploration Company, and the American Smelting & Refining Company, all of New York, recently opened an office at 115 Broadway, New York, as consulting engineer. Mr. Koester is author of two engineering treatises, "Steam Electric Power Plants" and "Hydroelectric Developments and Engineering."

MR. G. R. G. CONWAY has been appointed chief engineer of the British Columbia Electric Railway Company, from Feb. 1. The appointment is to a new position created on account of the rapid growth of the districts served by the company. Mr. Conway was formerly in charge of the water-works of Aberdeen, Scotland, as well as of several undertakings in Mexico. He came to Vancouver about the first of the present year to consult with the local management concerning the position and to look over the field.

MR. A. S. GRENIER, formerly general manager of the Pacific Power & Light Company, has been elected vice-president of that company, in charge of operation and construction. Mr. James E. Davidson, who has been new-business manager of the company, has been appointed general manager. Both officials have headquarters in Portland, Ore. Mr. H. R. Kingman has been made local manager of the North Yakima branch, vice Mr. H. E. Way, who has been appointed assistant to the chief engineer.

DR. EDMUND ARTHUR ENGLER has tendered his resignation as president of the Worcester Polytechnic Institute to take effect at the close of the present school year. Dr. Engler was graduated from Washington University, St. Louis, Mo., with the degree of A. B., in 1877. He received the degree of Ph.D. in 1892 and LL.D. in 1901. For twenty years, from 1881 to 1901, he was professor of mathematics at Washington University, and he served as dean of its School of Engineering from 1896 to 1901. In 1901 he was appointed president of the Worcester Polytechnic Institute.

MR. W. W. MOORE, who has been in the employ of the Wesco Supply Company, of St. Louis, for the past nine years in various capacities from that of traveling salesman to manager of the Birmingham branch, has resigned from its service to open an office for himself in the Empire Building, Birmingham, Ala. Mr. Moore, in addition to work as consulting and constructing engineer, especially along water and electric lighting plant lines, for which he is qualified both by training and by experience, will also act as manufacturer's agent for several lines of mine supplies and machinery.

Trade Publications.

CORLISS ENGINES.—The Allis-Chalmers Company has issued Bulletin No. 1510, which describes its direct-connected Reynolds Corliss engines.

TURBINE GOVERNORS AND PENSTOCK RELIEF VALVES.—The Ludlow Valve Manufacturing Company, Troy, N. Y., has issued a binder containing bulletins of its various water-wheel governors.

SIGN FLASHERS.—Bulletin No. 3 of the Reynolds Electric Flasher Manufacturing Company, Chicago, describes two popular flashing effects, script writing and chaser. The wiring connection for both are also given.

INSULATING JOINTS.—In its Bulletin No. 1101 the Wirt Electric Specialty Company, Germantown, Pa., gives illustrations, brief descriptions and complete price lists of insulating joints for electric and combination fixtures.

ELECTRIC HOISTS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued Bulletin No. 1445, covering its electric hoists intended for mine and other service. The bulletin supersedes Bulletin No. 1506 and is an exposition of modern hoisting practice.

WATT-HOUR METERS.—The Sangamo Electric Company, Springfield, Ill., is distributing Bulletin No. 20, giving full description of its mercury-flotation meters. Considerable information is given on the theory of operation, methods of making adjustments, etc.

TELEPHONE FITTINGS.—The K. & B. Company, Philadelphia, Pa., has issued a circular pertaining to its line of telephone fittings. These include devices for holding telephones within easy reach of desks, walls, etc., and include swinging and balanced brackets and pantograph arrangements.

FANS AND BLOWERS.—Ilg Electric Ventilating Company, Chicago, has circulated a loose-leaf catalog containing mechanical data and general descriptions of its blowers, ventilating sets, propeller fans, automatic shutters, etc. The data are given in the form of curves and tables and are valuable.

KNIFE SWITCHES.—Bulletin No. 25-A of the Mutual Electric & Machine Company, Wheeling, W. Va., illustrates and price-lists the company's full line of "Bull Dog" all-copper knife switches. These switches have large contact surface and milled and sweated contacts. Switches over 30 amp in size are regularly equipped with lugs.

LAUNDRY MACHINES.—The Hurley Machine Company, Chicago, manufacturer of the Thor electric laundry machines, has issued Catalog E, describing the product in detail and its uses. The Thor washer is designed on the reversing cylinder principle, and is built in various sizes and of different materials to suit various requirements.

STORAGE BATTERY INSTALLATION.—Bulletin No. 131, issued by the Electric Storage Battery Company, Philadelphia, describes the installation of "chloride accumulators" in the Lake Hopatcong Yacht Club, Lake Hopatcong, N. J. The club house is lighted by electricity furnished by a small gas-engine-driven set in conjunction with a storage battery.

INDICATORS.—Dobbie McInnes, Ltd., Glasgow, Scotland, manufacturers of automatic continuous indicators for steam and gas engines, reducing gears and all accessories for indicating purposes, have issued a pamphlet on the commercial value of indicator diagrams and instructions for the use of the engine indicator, together with leaflets and pamphlets covering their product.

NAME PLATES.—Catalog No. 5, issued by the Crowe Name Plate & Engraving Company, Chicago, illustrates in color the line of etched engraved signs, tablets, dials, plates, labels, etc., manufactured by the company. These include generator, motor, rheostat, meter, telephone and other name plates, having the name of the manufacturer and the rating of the apparatus, etc.

INSULATOR SUPPORTS.—Bulletin C of the Steel City Electric Company, Pittsburgh, Pa., describes and illustrates the malleable iron clamps made by it for securing insulators to exposed steel framework in wiring mills, foundries, factories, bridges, etc. The supports do away with the necessity of designing and making forgings, hook bolts, straps and other special rigging, and no drilling of holes is necessary.

CATECHISM ON DIRECT-CURRENT APPARATUS.—Under the above title, Fairbanks, Morse & Company, Chicago, have published an interesting booklet, giving in simple language definitions of electrical terms and describing the construction and uses of different electrical machines. As the title indicates, this treatise is prepared in the form of a series of questions and answers. The bulletin incidentally illustrates Fairbanks-Morse apparatus.

ELECTRIC SIGNS.—The 1911 catalog of the Flexlume Sign Company, Buffalo, N. Y., and St. Catharines, Ontario, illustrates the various types of signs made by the company and contains testimonial letters from users. The letters of the Flexlume signs are of prismatic glass molded in bold relief and only one lamp is used per letter. The sign is equally attractive by day and by night. The company also manufactures all types of signs from the smallest glass transparency to the largest exposed-lamp roof signs.

ELECTRIC LAUNDRY EQUIPMENT.—The Hurley Machine Company, of Chicago, has issued an attractive pamphlet (Catalog E) devoted to its electric laundry machines, both for the home and for commercial laundries. Washing machines, wringers and ironing machines are shown in various sizes and combinations. Westinghouse motors are used to drive the machines. A list of eighty-five parts of the laundry machine shows the care and attention needed in designing this class of apparatus.

MEGGERS AND BRIDGE MEGGERS.—A comprehensive 40-page catalog on this subject has just been published by James G. Biddle, Philadelphia. The descriptive matter was prepared by Prof. A. J. Rowland, of Drexel Institute, and contains a lot of valuable information on the subjects of insulation-testing and resistance measurements. A considerable number of illustrations and diagrams help to make the text matter clear, and the pamphlet is unusually interesting and valuable for what is really a trade publication.

STEEL FLUMES.—T. C. Egleston, Denver, Col., has issued Catalog No. 6 on Maginnis galvanized steel flumes for power, irrigation and mining canals. No solder or rivets are used in the flume. A flat sheet of galvanized steel is passed through a forming machine which leaves the

sheet in a semi-circular form, with a bead rolled in each edge of the sheet. A steel rod of the proper size to carry the weight of the flume is threaded at both ends for a nut and lies in the bead when the flume is in place. A steel channel rests over the bead on the inside of the flume and when the flume is assembled and the nuts tightened the rod draws tight in the hollow of the bead and the channel presses with the same force on the edges of the bead, thus forming a watertight joint.

BUSINESS NOTES.

THE ASBESTOS PROTECTED METAL COMPANY has established a Western office at 613 Fisher Building, Chicago, with Mr. Wilmot W. Burritt in charge as district manager.

ST. LOUIS FIXTURE HOUSES CONSOLIDATE.—The Gross Gas & Electric Fixture Company and the C. F. O'Reilly Electric Fixture Company, both of St. Louis, have effected a consolidation under the name of Gross-O'Reilly Chandelier Company, located at 1107 Locust Street, St. Louis.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY.—Mr. Charles E. Stahl, of Chicago, previously Western representative for the Mosier spark plugs and accessories, has been appointed Western representative for the Connecticut Telephone & Electric Company, of Meriden, Conn., manufacturers of ignition specialties and shock absorbers. The company will open a branch office at Chicago with Mr. Stahl in charge. Mr. E. D. Bright, special representative, will in the future take care of Eastern territory for the company. Mr. William H. Lolley, of the Remy Electric Company, will in the future cover the Detroit territory previously taken care of by Mr. Bright.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 14, 1911.

[Conducted by W F. Bissing, Patent Law,, 2 Rector St, N. Y. City.]

13,208. APPARATUS FOR SMELTING ORES YIELDING A VOLATILE METAL; Wm. McA. Johnson, Hartford, Conn. App. filed Dec. 12, 1910. An electric smelting furnace containing a porous-body carbonaceous material with electrodes in contact therewith and a condenser for the zinc product.

983,881. MAGNETIC SEPARATOR; A. & M. Dings, Milwaukee, Wis. App. filed March 16, 1905. A conveyor with an electric magnet above it, having pole pieces, a carrier extending across the conveyor and revolving in a plane parallel thereto and carrying a set of auxiliary pole pieces, each traveling past each pole-piece of the magnet, and a number of poles being in proximate relation to the pole-piece when crossing the conveyor.

983,887. PROCESS OF GRAPHITIZING; C. F. J. Forssell, Lakewood, O. App. filed April 22, 1907. Heats carbon and magnesia in an electric furnace above the temperature at which magnesium carbid can be formed until graphitization is effected.

983,888. METHOD OF GRAPHITIZING; C. F. J. Forssell, Cleveland, O. App. filed April 29, 1907. Heats carbon and sodium carbonate in an electric furnace above the temperature at which sodium carbid can be formed.

983,898. RINGING-KEY; E. R. Hobbs, Buhl, Idaho. App. filed Jan. 23, 1908. For telephone systems, including a cord circuit and plug, a master key, a plurality of selective switches, the master key controlling the connection of the ringing wire to the cord and a supplemental key determining whether one or a plurality of stations shall be rung.

983,905. TELEGRAPH SOUNDER; H. T. Johnson, New York, N. Y. App. filed June 25, 1908. Telegraph sounder for use on circuits of high or low resistance such as local circuits and line circuits, having a switch intermediate the magnet coils and sounder terminals, with means for connecting the switch so as to throw the coils in series and with one of the sounder terminals to connect the coils in multiple.

983,907. APPARATUS FOR GENERATING OZONE; C. Knips and E. Ey, Charlottenburg, Germany. App. filed Sept. 7, 1910. An air chamber, a water chamber and an ozone tube passing through the water chamber into the air chamber with compressed supply pipe connected with the air chamber, a water tank, a pipe connecting the tank with the water chamber and a pipe connecting the upper part of the tank with the air supply.

983,908. ELECTRIC SWITCH; F. W. Kurtz, New York, N. Y. App. filed Oct. 12, 1909. For throwing lights in and out for hallways, etc., by means of a base carrying contact plugs mounted on concentric rings with a manually operated switch arm carrying a pointer co-operating with a dial for controlling the same.

983,931. DETINNING AND DEGALVANIZING SCRAP; A. S. Ramage, Newark, N. J. App. filed July 3, 1909. Electrolyzes the by-product of the process, consisting of zincate of soda, thus producing metallic zinc and a resulting liquor which is reused.

983,932. MAGNETO ELECTRIC GENERATOR; F. I. & B. P. Remy, Anderson, Ind. App. filed March 20, 1909. An integral metallic frame open at the side whose ends receive center bearings, with an armature conductor shaft insertable therethrough, carrying windings and an inductor. The pole pieces are held in place by the magnets overlapping the frame and pole pieces.

983,933. AUTOMATIC PRESSURE GOVERNOR; W. J. Richards, Milwaukee, Wis. App. filed June 29, 1907. For controlling the operation of a motor compressor by means of a pressure-actuated switch, a quick make-and-break being produced by a magnet attracting the switch arm for accelerating its closing movement and for retarding its opening movement until the influence of the air pressure is sufficient to overcome the tendency or attraction of the magnet, thus producing a sudden opening of the switch.

983,943. ELECTRIC HAMMER; R. S. Smith, Marshall, Texas. App. filed July 28, 1909. Electric drop hammer whose head is attached to a plunger actuated by a solenoid and controlled by a hand lever.

983,966. TELEPHONE TESTING SYSTEM; C. S. Winston, Chicago, Ill. App. filed May 9, 1907. Cord circuit with a talking strand, testing strand, impedance coil, condenser and induction coil in series with a battery, one terminal of the impedance and condenser being connected with the test conductor during testing, a test receiving device and means for preventing connection between the testing conductor and the cord circuit during a complete connection for talking.

983,976. MOTOR CONTROLLING DEVICE; C. E. Carpenter, New York, N. Y. App. filed May 9, 1907. For starting, stopping and controlling an electric motor by means of a swtich forming the armature of a magnet whose pole pieces form contacts and a spring which under tension opens the switch, the contacts being kept closed until the spring is placed under tension.

983,979. AUTOMATIC ELECTRIC IGNITER FOR ORCHARD HEATERS; T. Chapman, Denver, Colo. App. filed Jan. 13, 1909. For igniting oil burners arranged about an orchard by means of a circuit controlling fusible devices which hold the contacts out of circuit and which are controlled by a thermostat. This opens the covers of the oil burners and igniters ignite the fuel.

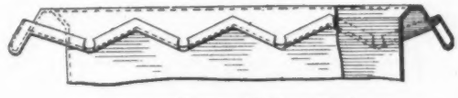
984,008. ELECTRIC SELF-WINDING CLOCK; W. H. Kallenbach and C. C. Bertsch, Boston, Mass. App. filed Oct. 26, 1909. A spring actuates a clock mechanism and is periodically rewound by the automatic operation of electrically energized winding mechanism.

984,011. PROCESS OF ETCHING BY ELECTROLYSIS ON RELIEF OR INTAGLIO; A. D. Lapointe, Sioux City, Ia. App. filed June 6, 1910. Applies a current of electricity to prints on zinc, etc., placed in a solution of a nitrate salt of the metal used.

984,016. VACUUM TUBE; D. McF. Moore, East Orange, N. J. App. filed March 17, 1910. A vacuum tube containing a chamber partially filled with liquid with porous inlet and porous outlet, the latter leading to the vacuum tube, the porous inlet and outlet both being unsubmerged by the liquid for one position of the chamber and one of them submerged for other positions, enabling ready shipment of the tube.

984,053. PULL SOCKET FOR INCANDESCENT ELECTRIC LAMPS; A. Weber, Sr. App. filed March 21, 1908. A shell with rotary switch removable from the casing and rotary shaft for operating it carrying a ratchet engaged by a pawl pulled by a cord.

984,068. BATTERY BOX; A. H. Brandon, Toledo, O. App. filed Jan. 12, 1910. The box has compartments for the cells with sheet metal fingers on the inside of the lid which press upon the terminals of the cells.



984,095.—Storage Battery Tank.

984,095. STORAGE BATTERY TANK; H. Lesley, Philadelphia, Pa. App. filed June 16, 1910. The tank has a lining which projects outwardly and downwardly from the top of the tank, the edge of which is angular to the top, to direct the drip.

984,097. TERMINAL; C. E. Lundgren, La Crosse, Wis. App. filed July 5, 1907. An electric terminal, including a shank with its end pointed and having a split edge to turn back the point as it is driven into engagement with the support.

984,108. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS; O. C. Roos, Cambridge, Mass. App. filed April 15, 1909. Two separated elevated receiving conductors are arranged with means for compensating for the phase difference between the oscillations, there being a receiving circuit associated with each elevated conductor and an oscillation detector with each circuit.

984,119. ELECTRIC FURNACE; H. I. Wood, Schenectady, N. Y. App. filed July 2, 1906. A resistance heater with a charge protecting envelope in proximity thereto, out of contact therewith, having high affinity for the materials of the heater, namely, carbon, and yielding a reduction product stable at the temperature at which carbon begins to disintegrate.

984,123. CARTRIDGE FOR MELTING FURNACES; M. R. Conley, New York, N. Y. App. filed May 17, 1910. A cartridge for melting furnaces composed of thin sheet metal to contain the charge and of the same shape and size as the interior of the furnace.

984,125. COMMUTATOR; W. A. Dick, Pittsburg, Pa. App. filed Sept. 20, 1906. Has a clamping ring with a plurality of rings between the clamping ring and the cylinder segments, some of which have an outer flange at one side and an inner flange at the other side.

984,128. ELECTRIC LIGHTING SYSTEM; E. M. Fitz, Columbus, O. App. filed Feb. 13, 1909. An electric lighting system with a main circuit, an auxiliary circuit, a switch for interrupting the circuits alternately and means for supplying a lighting circuit and a lower heating circuit for different positions of the switch.

984,129. INSULATING TUBE; C. LeG. Fortescue, Pittsburg, Pa. App. filed June 9, 1910. Of the condenser type, comprising a plurality of telescoping sections, each having alternate layers of insulating and conducting material.

984,130. WATERPROOF ELECTRICAL SOCKET; E. H. Freeman, Trenton, N. J. App. filed Nov. 30, 1910. Plug socket, consisting of two sections connected by a spring snap with an outside protector casing inclosing the receptacle and holding the sections together, the sections of the casing being screwed together to form a lock for the snap.

984,154. ELECTRICAL SIGNALING AND ALARM APPARATUS; C. H. Pool, New York, N. Y. App. filed Nov. 8, 1910. An electrically controlled signal in circuit with a test circuit with an additional source of current and alarm, the latter normally open. A thermostat controls the alarm and operates the signal and the alarm, the alarm being in the nature of a loud-speaking telephone.

984,156. INSULATING STRUCTURE; A. B. Heynders and H. E. Mateer, Wilkinsburg, Pa. App. filed May 13, 1909. Insulating bushing for separating transformer leads, consisting of concentric cylinders of conducting material separated by insulating cylinders with overhanging skirts of conducting material mounted upon the exposed ends of the cylinders, the cylinders being of greater lengths to provide steps.

984,160. METHOD OF TESTING ELECTRIC TRANSFORMERS; M. C. Rypinski, Pittsburg, Pa. App. filed Dec. 6, 1907. For testing the polarity of ratio of transformation of transformers by means of an indicating instrument, a switch and suitable circuit connectors.

984,175. LIGHTNING ROD; C. E. Yarian, Galion, O. App. filed March 7, 1910. For the ground connection of a lightning rod to keep it moist by means of a pipe to which water may be supplied by a funnel extending above the ground, the pipe being perforated and containing the end of the rod.

984,182. MAGNETIZABLE WEDGE FOR DYNAMO-ELECTRIC MACHINES; J. M. Barr, Wilkinsburg, Pa. App. filed Aug. 2, 1909. A coil-retaining wedge for open-slot dynamos, comprising a yielding magnetizable bar of channel shape and a non-magnetizable wedge forced into the bar to expand it.

984,202. SELECTIVE SIGNALING SYSTEM; J. Erickson, Chicago, Ill. App. filed Aug. 16, 1905. A line circuit with a plurality of signals and a call for selectively operating the signals, including generators in series grounded at a point between them, each signaling means comprising a polarized ringer with magnet for preventing the bell from ringing, the operating circuit of one signal including the bell in series with a winding of its associated magnet.

984,203. SELECTIVE SIGNALING SYSTEM; J. Erickson, Chicago, Ill.

984,182.—Magnetizable Wedge for Dynamo-Electric Machines.

App. filed Aug. 16, 1905. A line circuit with a plurality of signal receivers, a calling apparatus for selectively operating a signal, the calling apparatus including synchronized alternating generators connected in series and grounded at a point between them with a normally closed shunt around the bell of the signal, which is automatically opened when the bell is to be rung.

984,204. LOCK-OUT FOR PARTY LINE TELEPHONE SUBSCRIBERS' STATIONS; J. Erickson, Chicago, Ill. App. filed April 16, 1906. Switch springs and subscribers' switch hook for directly operating the springs with an electro-magnet having an armature for controlling the springs, the parts being removable as a unit.

984,210. SPRINKLER ALARM SYSTEM; A. Goldstein and H. F. Blackwell, New York, N. Y. App. filed April 13, 1910. A conduit for liquid flow, a by-pass normally open, a water-wheel in the by-pass which drives an electric generator which rings an alarm.

984,211. ELECTRICAL ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed Aug. 6, 1910. A telephone circuit, including subscribers and central station receiving and transmitting apparatus with call signals and a protective circuit, with means for indicating trouble on the protective circuit at a distant point and means independent of the telephone and call for signaling over the telephone from the distant station.

984,218. SELF-WINDING ELECTRIC CLOCK; R. L. Hight, Decatur, Ill. App. filed Sept. 10, 1909. Intermittently wound, and means for automatically controlling the re-winding by an electric magnet.

984,224. ELECTRIC TAPLET; N. Klein, New York, N. Y. App. filed Dec. 16, 1909. An electric taplet block for splicing or tapping wires having grooves and recesses for the wires. Details.

984,235. TELEPHONE SYSTEM; A. Nemeth, New York, N. Y. App. filed Aug. 20, 1910. For reproducing news by means of a series of microphones manually controlled from a central station and arranged over a line.

984,238. SWITCH; G. E. Palmer, Winchester, Mass. App. filed June 25, 1910. Switch device fused on one side which can be so adjusted that line wires may be led from either side to the switch and the service wires led off from the other side without crossing the wires, the switch contacts being operated by a sliding rod and handle.

984,245. ELECTRIC LAMP SOCKET; J. S. Stewart, New York, N. Y. App. filed Oct. 13, 1909. Keyless lamp socket suspended from a cord with upper and lower housing, the lower housing telescoping over the upper and locked together by tongue and groove with U-shaped clip.

984,248. MEANS FOR STARTING VAPOR CONVERTERS IN SERIES; P. H. Thomas, Montclair, N. J. App. filed March 8, 1907. A plurality of rectifier bulbs in series, each having two main annodes, two supplemental annodes and a cathode, supply and load circuits and connections therefor, with separate means for passing current between the supplemental anodes and the cathode and starting connections external to the bulb between the source which is connected with the main anode and the supplemental anodes.

984,260. DYNAMO ELECTRIC MACHINE; H. G. Berensten, Pittsburg, Pa. App. filed July 28, 1909. Avoids machine work in trimming castings by bolting the parts together and providing spacing bushings with tapered end to fit into recesses, through which bushings the bolts pass.

984,286. TROLLEY ATTACHMENT; F. J. Moeller and F. J. Seyerle, Pittsburg, Pa. App. filed Sept. 16, 1909. Trolley harp with guard plates on opposite sides of the wheel and a cable connected to the guard plate.

984,297. ELECTRIC METER; W. H. Pratt, Lynn, Mass. App. filed April 20, 1904. Alternating current induction meter, particularly a Watt meter with magnetic core having two small air gaps, poles on each side of each air gap, a potential coil to magnetize the core, a second magnetic core with pole opposite the air gaps and series coils on the last-named poles.

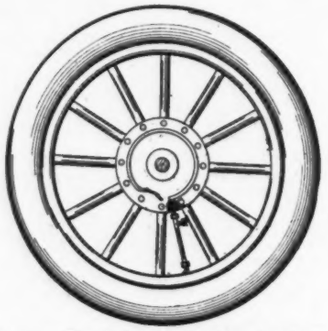
984,308. PREHEATER AND REDUCER FOR ELECTRIC SMELTING FURNACES; A. Stansfield, Montreal, Canada. App. filed Nov. 11, 1909. A furnace with the chambers one side thereof, an inclined chute connecting the chamber and the furnace, a combustion space above the chamber and pipes in the space communicating with the chamber and space.

984,315. GAS IGNITER; C. B. Stilwell, Wayne, Pa. App. filed Feb. 24, 1909. For igniting the gas from a burner by means of a revolvable valve carrying a nozzle driven by a pinion with a sparking mechanism for igniting the gas escaping from the nozzle, the latter igniting the main burner.

984,325. COMBINATION CIRCUIT CONTROLLER; J. L. Wagner, Chicago, Ill. App. filed Nov. 2, 1905. Combination lock for preventing tampering with the circuit so that the circuit cannot be closed until the lock is in a definite position.

984,327. MOTOR CONTROL APPARATUS; D. Wald, O. C. Britsch and M. Taigman, New York, N. Y. App. filed April 23, 1910. For starting, stopping and controlling electric motors, such as the motor of a sewing machine, the treadle of which operates the control apparatus. Details.

984,371. ELECTRIC FURNACE; H. Hoff, Dudelingen, Luxemburg. App. filed Sept. 25, 1909. An open hearth with a slanting passage,



984,453.—Tire-Inflation Testing Appliance.

a conduit projecting thereinto for conveying air to the furnace and a pipe for conveying coal dust into the conduit.

984,453. TIRE-INFLATION-TESTING APPLIANCE; E. A. Terpening, Geneseo, Ill. App. filed April 28, 1906. A Bourdon spring tube which is connected with the air pressure in the tire actuates an alarm mechanism when the air pressure reduces.

984,459. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed March 20, 1908. Three-phased circuit with means for suppressing harmonics developed by the synchronous apparatus.

984,467. SYSTEM OF ELECTRICAL DISTRIBUTION; J. Bijur, New York, N. Y. App. filed March 26, 1908. An alternating circuit with storage battery for regulating fluctuation of load, a rotary converter and an alternating booster between the work circuit supplied by alternating current and the storage battery.

984,472. PURIFIER; C. W. Clark, Los Angeles, Cal. App. filed Sept. 3, 1909. Electrolytic liquid purifier containing a series of coils of wire suitably spaced and forming electrodes and removably secured to sections.

984,496. CARBON HOLDER FOR ARC LAMPS; W. N. Selig, Chicago, Ill. App. filed Feb. 11, 1910. A bracket with a U-shaped head and clamping block with a rounded-end carbon contacting surface slidably mounted within the head and screw for actuating the block.

984,502. SIGNAL ATTACHMENT FOR LETTER BOXES; W. E. Williams, Wilkes-Barre, Pa. App. filed Aug. 2, 1910. For rural free delivery, which rings an alarm when the letter is deposited.

984,503. PRODUCING CALCIUM; W. G. Arsem, Schenectady, N. Y. App. filed Aug. 18, 1909. Decomposes calcium carbid by heating it in a vacuum and collecting and condensing the resultant vapor by means of an electric furnace.

984,507. DENTAL MOTOR; W. E. Butler, David City, Neb. App. filed Sept. 3, 1909. May be operated by a battery with a single pair of main conductors leading to the armature of the motor, two pairs of circuit terminals in the main conductors and a series of contacts in coactive relation with the circuit terminals and grouped to actuate the motor in one direction or the other and to short-circuit the armature.

984,511. ELECTRIC MOTOR CONTROLLING APPARATUS; H. W. Leonard, Bronxville, N. Y. App. filed May 11, 1909. Means for controlling the armature and field, including two low-voltage windings, connected in series, one controlling the field.

984,520. FLUOROSCOPE; C. E. Campbell, Lynn, Mass. App. filed March 12, 1910. Fluoroscope with collapsible body extended by a pair of arms.